REPORT DOCUMENTATION PAGE			*Form Approved* *OMB No. 0704-0188*

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	21.Jun.00	DISSERTATION

4. TITLE AND SUBTITLE
A DECISION TOOL TO SUPPORT STRATEGY SELECTION FOR SOFTWARE DEVELOPMENT OUTSOURCING

5. FUNDING NUMBERS

6. AUTHOR(S)
MAJ HERMANN BRIAN G

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
ARIZONA STATE UNIVERSITY

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
THE DEPARTMENT OF THE AIR FORCE
AFIT/CIA, BLDG 125
2950 P STREET
WPAFB OH 45433

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
FY00-221

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Unlimited distribution
In Accordance With AFI 35-205/AFIT Sup 1

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

20000718 029

14. SUBJECT TERMS	15. NUMBER OF PAGES
	250
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

DTIC QUALITY INSPECTED 4

Standard Form 298 (Rev. 2-89) (EG)
Prescribed by ANSI Std. 239.18
Designed using Perform Pro, WHS/DIOR, Oct 94

A DECISION TOOL TO SUPPORT STRATEGY SELECTION FOR SOFTWARE DEVELOPMENT OUTSOURCING

by

Brian Gustav Hermann

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

ARIZONA STATE UNIVERSITY

August 2000

A DECISION TOOL TO SUPPORT STRATEGY SELECTION FOR SOFTWARE DEVELOPMENT OUTSOURCING

by

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has been approved

May 2000

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Supervisory Committee

ACCEPTED:

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Department Chair

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Dean, Graduate College

ABSTRACT

Software development organizations are among an increasing number of companies turning to outsourcing as a strategy to improve cost control, product quality, product development schedule reduction, and focus on core business activities. Outsourcing consultants promise all of these benefits and more, but nearly thirty percent of all outsourcing relationships end in dissatisfaction. In response, several authors have published suggestions for successfully using outsourcing to meet goals. These suggestions are based on anecdotal consulting experience and do not clearly identify whether those experiences are relevant to specific domains or organizational goals.

This research effort expands upon the anecdotal software outsourcing literature by employing a broad survey to identify the types of outsourcing strategies, their applicability to specific project scenarios, and their abilities to achieve project and organizational goals. The specific project scenario variables represent the drivers that determine whether outsourcing strategies are successful. Success is defined in terms of organizational and project goals. The factors and historical experience data were combined to produce a framework and yielded guidelines or rules. The rules, in turn, were used to construct a decision support tool to aid software development project managers and consultants in making their outsourcing strategy decisions for specific projects.

To Leslie

for unfailing love and support

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1. Introduction

Today's business environment has led many companies to streamline business processes and outsource activities not considered "core" business functions. In many businesses, software development is classified as a non-core activity (Vijayan). In addition, "The software industry has achieved a notorious reputation for being out of control in terms of schedule accuracy, cost accuracy, and quality control" (C. Jones "Software Project Management in the 21st Century"). In response to these problems and business trends, software developers have tried process improvement techniques, project management techniques, and are now outsourcing software development in increasing numbers (DiRomualdo and Gurbaxani). Like their counterparts in the remainder of the business world, software developers think an outsourcing vendor can do the job cheaper, faster, and with higher quality than current in-house efforts. Unfortunately, nearly thirty percent of outsourcing relationships end in dissatisfaction, failure, or litigation (C. Jones "Conflict and Litigation between Software Clients and Developers"). This figure is slightly higher than the 24 percent overall industry average for failed projects that result in termination (C. Jones Patterns of Software System Failure and Success). While some authors suggest how to structure an outsourcing contract and monitor the resulting effort, none offer advice on how to select appropriate outsourcing strategies to meet specific project goals.

The term software acquisition has long been used to describe situations where a customer contracts with a software development organization for the complete development of a software product (possibly including life cycle maintenance).

Outsourcing can be distinguished from acquisition by the level and type of effort agreed to by the developer and customer. Without calling their business arrangements "outsourcing," companies have long outsourced software functions, entire software projects, and software development phases (process components). The following definition encompasses all of the currently recognizable business relationships that constitute software outsourcing.

Software Outsourcing: Contracting (or subcontracting) with an external organization for:

- the development of complete or partial software products,
- the purchase of packaged or customized package software products, or
- activities to aid in the software development life cycle.

This research identified outsourcing strategies, motivations, benefits, drawbacks, and relevant project situation variables to produce a taxonomy structure. This structure will encompass the factors necessary to make an outsourcing strategy decision. Industry experience will then be tapped to build decision heuristics into the framework and ultimately produce a decision support tool to aid software development project managers and consultants in making their outsourcing strategy decisions for specific projects. There are six specific research goals shown in Table 1.

1.	Identify the different types of software outsourcing
2.	Determine motivations for software outsourcing
3.	Establish the benefits and drawbacks of each type of outsourcing
4.	Identify the project scenario variables where each type of outsourcing is likely to succeed or fail
5.	Combine the outsourcing experience information into a multi-dimensional framework
6.	Produce a decision support system that will enable users to select successful outsourcing strategies for their project situation and goals.

Table 1: Research Goals

Chapter 2 explains the concept of outsourcing strategies and some related outsourcing literature. Previous work is shown both to present concepts and to verify it fails to meet the objectives shown above. Chapter 3 identifies the research methodology used to meet the goals shown in Table 1. Chapter 4 outlines the results of survey data analysis and development of rules-of-thumb which become the basis for a decision support tool (discussed in Chapter 5). The final important task of validation is extensively described in Chapter 6. Finally, Chapter 7 reinforces the research contributions and identifies future work that can build upon this effort.

2. *Background*

Section 2.1 presents definitions of software outsourcing types and strategies and represents a new, useful model for understanding software outsourcing. The remainder of this chapter outlines related software outsourcing literature. In anecdotal fashion, this literature presents some useful ideas for why organizations are outsourcing software development, what can go wrong in an outsourcing development, and how to manage an outsourcing relationship. This research effort built upon the anecdotal suggestions by surveying software outsourcing across many domains to broaden the understanding of software outsourcing beyond the experiences of a few published consultants.

2.1 Project-Level Outsourcing Strategies

Figure 1 shows a high-level view of the software outsourcing domain. Each of these categories of outsourcing must also be further explained. Figure 2 shows the two dimensions of an outsourcing strategy. The first dimension, percentage of in-house product development, indicates the portion of a software product that is developed in-house. The second dimension, percentage of development process phases accomplished in-house, defines the total in-house contribution to all process phases of software development. For example, if a software developer outsourced a third of a software product and also outsourced software testing, the effort could be placed in Figure 2 at approximately point A.

In-house efforts [Figure 3] are those efforts where the entire development is accomplished within a customer organization. This type of software project forms the border of the outsourcing definition. All but this rapidly shrinking category of projects

involve some amount of outsourcing. Many organizations have information technology (IT), prototyping, applications, or otherwise-named departments responsible for in-house application development. Fewer and fewer of these organizations develop products without outsourcing assistance in the form of product components, process assistance, or outside general development support.

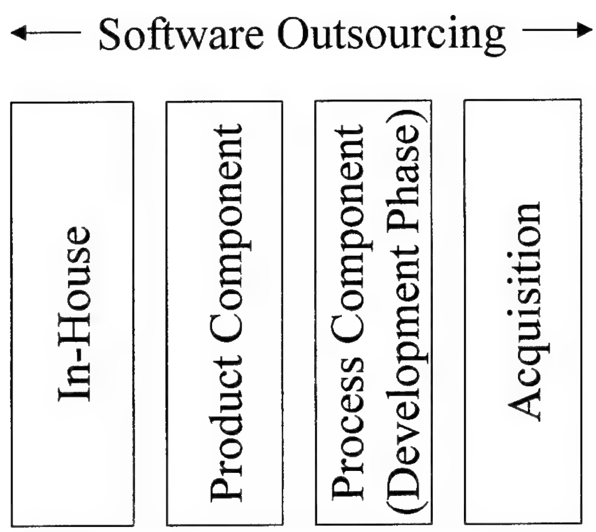


Figure 1: Software Outsourcing Domain

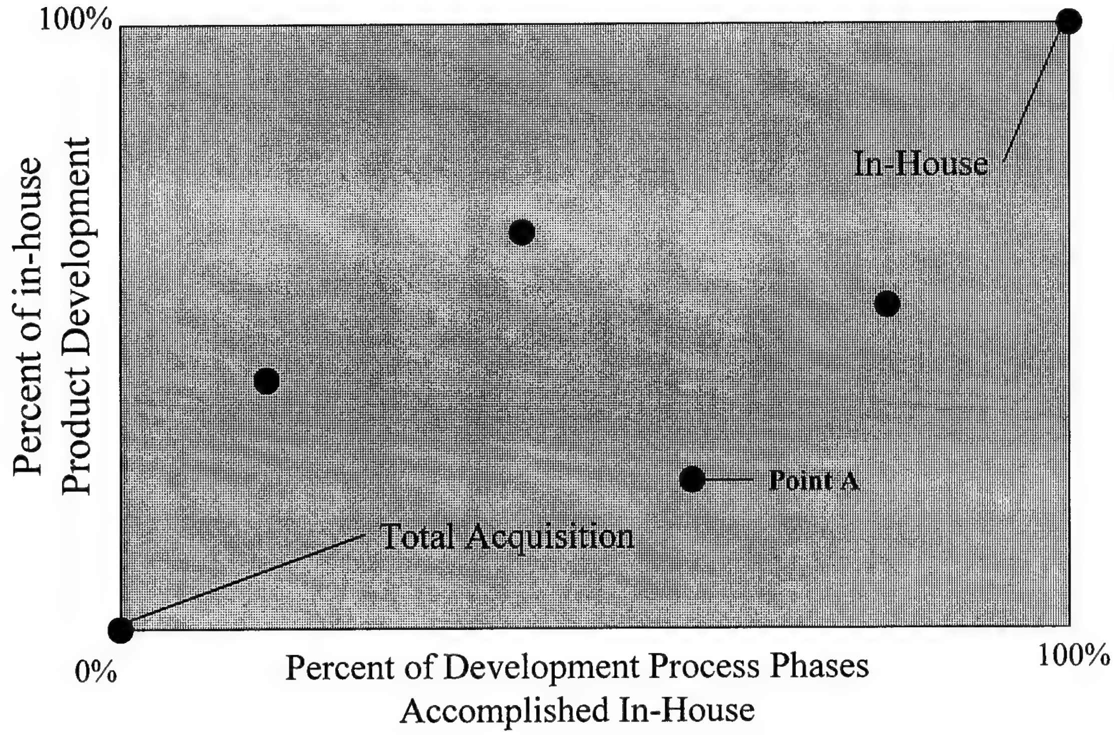


Figure 2: Dimensions of Software Outsourcing

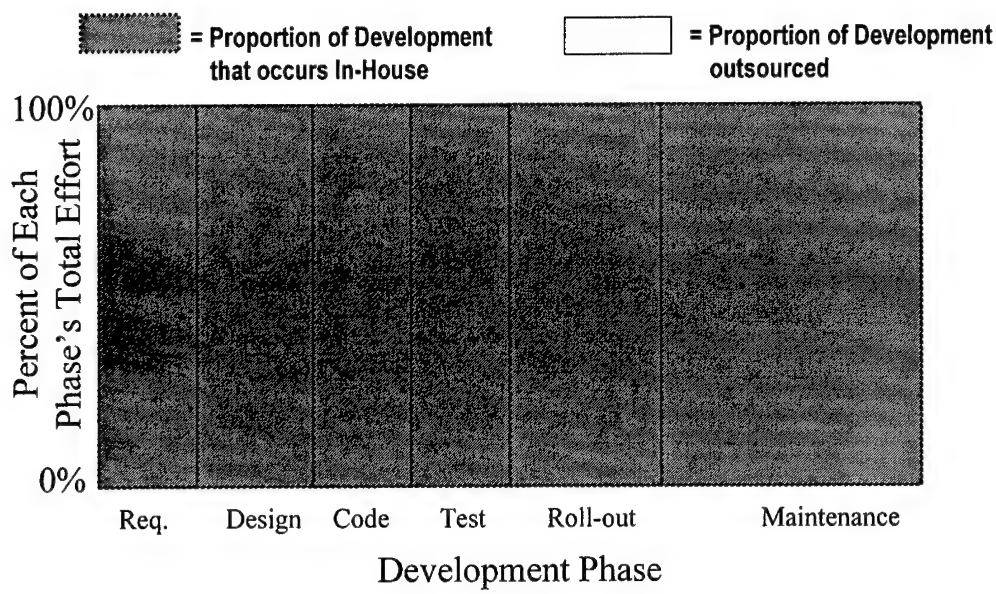


Figure 3: In-House Effort

The first type of outsourcing, product component outsourcing, is perhaps the simplest outsourcing arrangement to explain. In this scenario, a developer is contracted to provide a part of an overall system. Figure 4 shows an example of a total system where components (e.g., fire controls) can be developed separately from the other system components. This technique includes acquisition of re-usable components, customization of common applications, complete custom component development, and many hybrid combinations thereof.

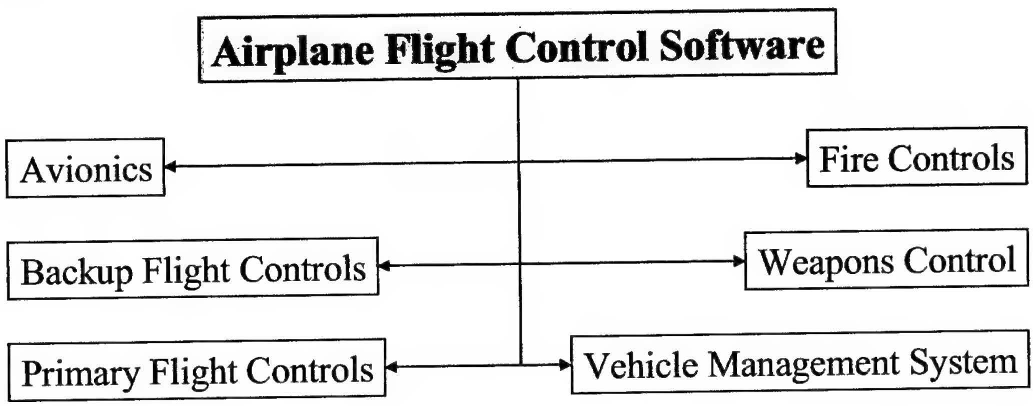


Figure 4: System Component Outsourcing

Figure 5 shows hypothetical effort levels for each phase of a product component outsourcing software development project. In its simplest incarnation, product component outsourcing is essentially hiring a vendor to complete a horizontal cross-section of the overall project effort. Since all systems are unique, the concept of varying effort levels across development stages is more important than the actual levels shown in the figure.

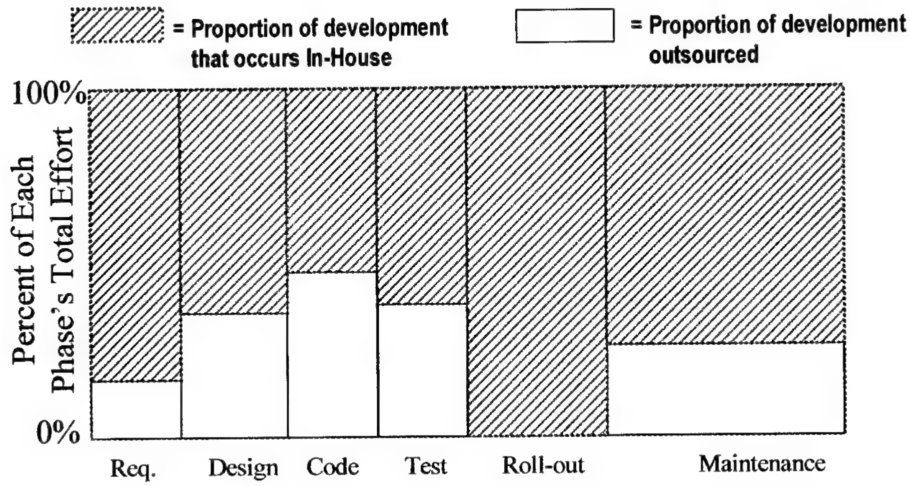


Figure 5: Outsourcing a Product Component

In the next scenario, process component outsourcing, the customer organization simply contracts for an external group to perform all or part of the functions of one or more of their process steps or components [Figure 6]. Simply put, a vendor is chosen to perform a vertical slice of the project effort. One traditional example is contracting for system-level software testing shown in Figure 7 (Kaner). Notice in Figure 7 that some portion of the testing effort (e.g., integration testing) could remain in-house along with the responsibility to manage the vendor relationship.

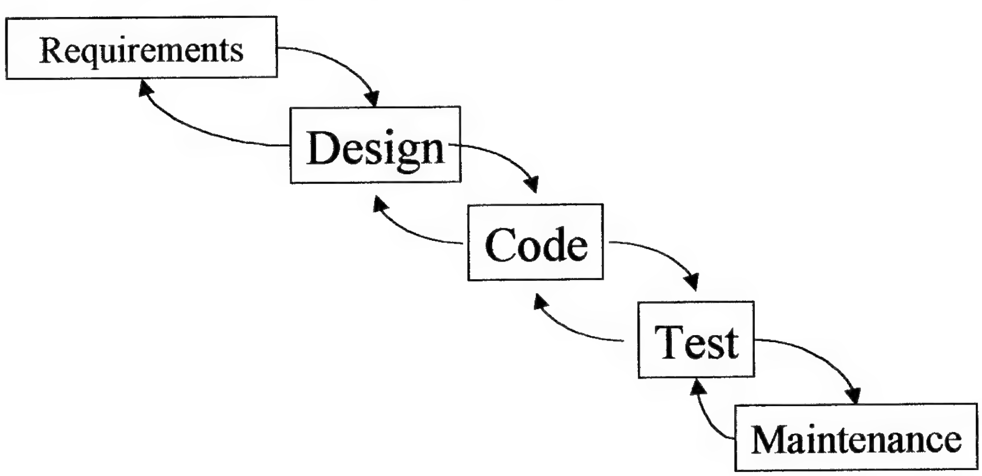


Figure 6: Process Component (Development Phase) Outsourcing

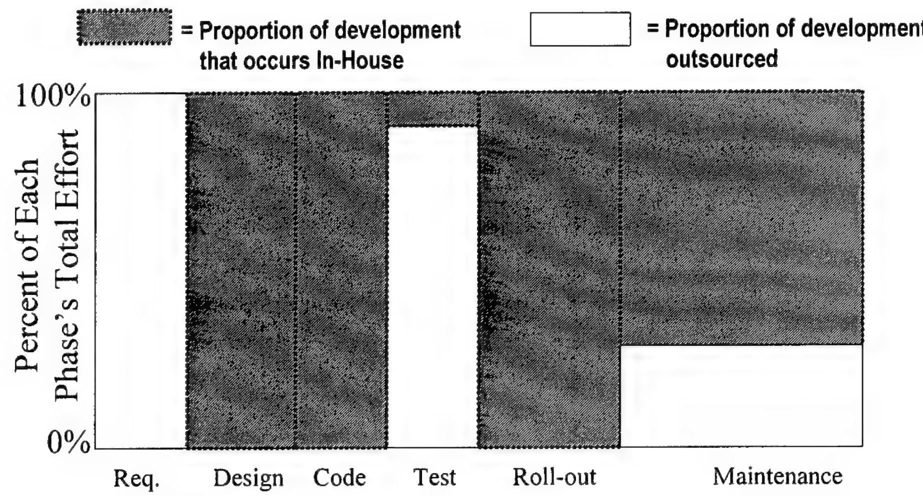


Figure 7: Outsourcing a Process Component (Testing Component Shown)

Finally, at the other end of the spectrum from in-house efforts are traditional acquisitions, shown in Figure 8 and discussed above. The U.S. military and government agencies lead the software industry in both procedures and understanding of software acquisition efforts (Joodi and Burklo). Current outsourcing literature focuses on this strategy for software development and information technology service/infrastructure outsourcing. Figure 8 shows the in-house versus contractor effort to a total acquisition software development project. Notice that some level of in-house effort is required to oversee contractor software development.

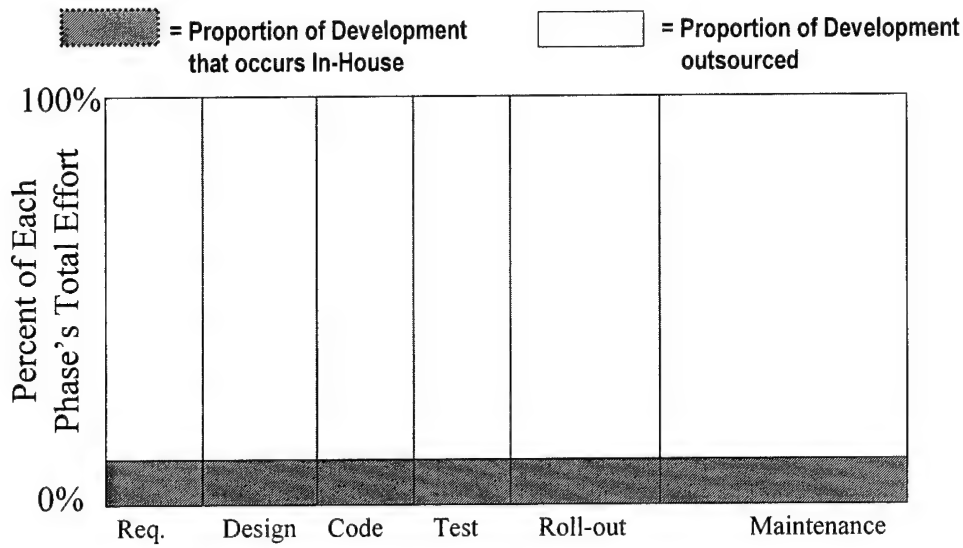


Figure 8: Total Acquisition

2.2 Project Planning and the Outsourcing Process

Most software developers begin a development project by planning. Among many other things, a development plan includes project organization and whether and how outsourcing may be used during development. The outsourcing strategy is the type of outsourcing or combination of outsourcing types used on a project. For example, when developing flight control software for an aircraft, the prime developer may select a strategy of outsourcing both the system level software testing and development of the avionics software subsystem.

2.3 Outsourcing Motivations

Companies turning to outsourcing for software development are typically under pressure to deliver high-quality products -- within budget and schedule constraints. These project goals as well as organizational policies are the core motivations for

software outsourcing. Table 2 shows a published list of outsourcing motivations (Thomsett "Outsourcing: The Great Debate").

- Reduced costs (economies of scale),
- Access to experience and skills,
- Reduced development duration,
- Risk sharing,
- Elimination of 'non-core' activities,
- Improved control, focus, professionalism, and
- Cash flow from sale of intellectual property.

Table 2: Outsourcing Motivations

All but the last three of these motivations are self-explanatory. Managers wanting to eliminate 'non-core' activities must consider which capabilities they intend to be strategic to the future of their organization. Thomsett suggests that outsourcing strategic capabilities is rarely a good idea, but is sometimes necessary for surge capacity (Thomsett "Outsourcing: The Great Debate"). Some managers believe that their internal software development departments are out-of-control and that a contractual relationship with developers will actually improve their visibility into development and focus on software development costs and importance. Other organizations want to divest their current software property and desire payment from an outsourcing organization that will take over the rights to the software. In this case, the outsourcing vendor is free to market the software outside the customer organization. Most organizations choose to outsource for a subset of these documented motivations.

2.4 Outsourcing Drawbacks

While organizations enter into outsourcing arrangements with high-expectations, published research in the literature suggests these relationships are often less than

satisfactory (C. Jones "Marry in Haste, Repent at Leisure: Successful Outsourcing Requires Careful Consideration and Preparation" ; Demarco and Lister ; Yourdon). According to Demarco and Lister, 29 percent of outsourcing relationships result in some dissatisfaction, dissolution of the relationship, or litigation (Demarco and Lister). Apparently outsourcing involves trading old risks for new. Table 3 lists several often-overlooked drawbacks to outsourcing (Thomsett "Outsourcing: The Great Debate").

- Increased cost
- B-team syndrome (vendor's substitution of less qualified personnel for those originally specified)
- Increased risks
- Conflicting agendas
- Reduced control
- Loss of intellectual capital
- Contractual overhead
- Litigation

Table 3: Outsourcing Drawbacks

2.5 Best Practices for Managing an Outsourcing Relationship

In response to these problems, many authors have proposed guidelines for selecting vendors, structuring contracts, and managing outsourcing relationships. Some of these ideas are presented in the following sections.

2.5.1 Contractual and Legal Issues

Naïve organizations begin outsourcing with unrealistic expectations of simply deleting some in-house effort -- without planning for the overhead required to establish and to monitor the contract. While software engineers are typically not excited about project and contract management details, some authors suggest that a solid contract and legal advice may be the most importation actions required for successful outsourcing

(Thomsett "Outsourcing: The Great Debate" ; Yourdon). According to Demarco and Lister, "it is not unusual for a large software development organization have upwards of 50 active cases on its hands. Litigation costs … would be (when spread across unlitigated as well as litigated projects) a larger component than coding" (Demarco and Lister).

2.5.2 Vendor Selection

Once an organization has decided to outsource, selecting a vendor is the next important task. Table 4 shows the top seven factors currently considered when selecting a software outsourcing vendor (Yourdon, Rubin and Mohnot). While the initial decision to outsource is frequently made to reduce costs, Yourdon concluded that it is just the fifth most important factor in picking an outsourcing partner.

- Language (Programming) Familiarity
- Telecommunications Connections
- Spoken Language
- Large Staff
- Price
- Rapid Start
- Credentials

Table 4: Important Outsourcing Vendor Selection Factors

2.5.3 Planning to Avoid Problems

Since disagreements are bound to arise, several authors suggest customers spend more time ensuring that the outsourcing contract properly addresses the contractual aspects of software estimation, payment strategies, and management reviews. While not the focus of this research effort, we found that structuring the agreement also impacts the success of an outsourcing relationship. This section is included to explain the key

aspects of outsourcing contracts and their relationship to potential decision support inputs shown later.

2.5.3.1 Project Estimation

Capers Jones suggested that function points are the best technique for estimating project size (C. Jones "Marry in Haste, Repent at Leisure: Successful Outsourcing Requires Careful Consideration and Preparation"). He also explained that function points and proper contract wording could help eliminate conflicts when requirements creep. Although software estimation has a poor track record, "projects that use formal estimating tools … have much better track records of staying within budgets and actually finishing without serious mishaps" (C. Jones "Marry in Haste, Repent at Leisure: Successful Outsourcing Requires Careful Consideration and Preparation"). Jones noted that outsourcing has produced new requirements for higher-level estimation shown in Table 5.

• Portfolio growth, maintenance, and retirement
• Latent defects and the impact of quality control
• Staffing by occupation group
• Head-count of staffing by time period
• Effort by time period
• Costs by occupation group and time period
• Special factors such as mass Year 2000 upgrades
• Inflation rates

Table 5: High-Level Software Estimation Requirements

Jones also suggested that these estimation features could help curb the increasing percentage of software litigations, dissatisfaction, and contract re-negotiations (C. Jones "Software Project Management in the 21st Century").

2.5.3.2 Payment Strategies

In addition to estimating the effort properly, contracts should delineate payment schedules, costs, and profit sharing. Preferably, parties should agree to an equitable arrangement where the developers are paid for functionality rather than code volume thus reducing the urge to add unnecessary functions and requirements. The metrics used to track progress for quality and payment should also be defined. Customers should provide for insight into the outsourced development effort to help manage overall effort.

2.5.3.3 Project Personnel Experience

One common complaint about software acquisition is that developers bid a more highly experienced team than actually used once the contract is awarded. Sound contracts include information about required experience and skill levels to help ensure the actual team quality matches the proposed team quality.

2.5.3.4 Reviews and Oversight

Both parties should also agree to joint project management and technical reviews that include risk management to incentivize early/frequent identification and resolution of project risks. The Software Program Manager's Network suggests that low level "inch-pebbles" (rather than high-level milestones) must be established to identify clear transitions from one project phase to another. Customer involvement in reviews and the decision authority for these transitions must be spelled out in the contract (SPMN). Finally, Thomsett suggests that ownership of legacy code and developed components should also be clearly defined (Thomsett "Outsourcing: The Great Debate"). While

items in Table 2 motivate customers, developers may be motivated to develop a product they hope to re-use throughout the market.

2.5.4 Communication Issues

The most widely discussed software outsourcing strategy is to acquire an entire software product from a company outside their home country. "Offshore Outsourcing" has schedule and price improvement potential, but presents other unique challenges. Offshore outsourcing efforts appear to magnify challenges experienced by in-country outsourcing arrangements. In addition to varied corporate cultures, international outsourcing challenges both parties with language barriers, cultural misunderstandings, and communications infrastructure shortfalls as explained in the following sections.

Obviously, arranging delivery of products, scheduling meetings, and answering questions become more difficult when locations are on opposite sides of the earth. If some overlap exists, however, the time difference can be used to create a longer 'virtual' workday (Watanabe).

As shown in Table 4, sharing a common language is the third most important factor in selecting an outsourcing partner. Obviously the ability to explain and understand requirements is crucial to producing a suitable and effective system. In addition to language, some cultures encourage far less questioning and sharing of opinions from employees than can be expected of employees in U.S. companies. As a result, U.S. customers must work to extract questions, risks, and opinions from Indian offshore developers. Well-understood cultural interactions will help improve project communication.

In addition to distances and language differences, deciding how and when to communicate often requires offshore developers improve their communication infrastructure and connectivity to the customer organization. While most U.S. developers have excellent Internet and e-mail access, many foreign countries lag somewhat behind. Time zone, location, and language differences strengthen the need for groupware tools that enable communication between offshore vendors and their customers. Video teleconferencing, file transfer, e-mail, web tools (dashboards, chat windows, discussion boards, and whiteboards), and telephone communications are typically part of a shared suite of tools required to meet offshore outsourcing communication needs (Coleman ; Nunamaker et al. ; Sproull and Kiesler ; Ackermann and Starr).

2.5.5 People Issues

Outsourcing is often a controversial issue for customer organizations. When entire projects are outsourced, in-house jobs are often transferred or eliminated. In addition, outsource developers are not normally as well versed in domain expertise as in-house developers. If requirements are not communicated clearly, resulting systems may not meet user expectations.

2.6 Outsourcing Metrics

Outsourcing metrics can be categorized into nine classes as shown in Figure 9 (Yourdon, Rubin and Mohnot). These classes match those required for thorough tracking of any in-house effort. The only major difference appears to be that outsourcing metrics collection, definition, and visibility must be explicitly defined in the development contract. Surveys during this research attempted to capture relevant project variables and

outsourcing strategies for correlation with goal satisfaction. Some outsourcing metrics questions were also asked to assist other research on modeling the outsourcing development and study the relationship between vendor tracking and goal satisfaction.

- Finance and budget
- Customer satisfaction
- Work product delivery
- Quality
- Time and schedule
- Business value
- Operational service levels
- Human resources
- Productivity

Figure 9: Outsourcing Metrics Classes

2.7 Contrast between Software Outsourcing and IT Outsourcing

Outsourcing is in vogue for a wide range of businesses from farming to chemicals to information technology to software development (Kaner ; Anthes ; Brandel ; Wee ; Donahue ; Cole-Gomolski ; Opperthauser ; Gallivan ; Klenke ; Lacity, Willcocks and Feeney ; Kiechel ; McFarlan and Nolan ; Lacity and Hirschleim ; King ; Hoffman ; Nadile). In 1998 information technology outsourcing exceeded $99 billion and is expected to reach more than $151 billion by 2003 (U.S. And Worldwide Outsourcing Markets and Trends 1998-2003). Software development outsourcing, however, differs from most outsourcing because companies are attempting to contract complex, intellectual 'project' work rather than typical repetitious, well understood 'process work' (Thomsett "Outsourcing: The Great Debate"). For example, many companies have outsourced hardware computer support. Hardware computer support certainly requires intelligence and experience, but it is largely repetitious and somewhat simpler than

developing software products from high-level user requirements. As a result, the vast collection of IT outsourcing experience literature is of limited value to a customer trying to select an outsourcing strategy to meet an organization's software development goals (Thomsett "Software Development Outsourcing"). While some outsourced software effort may be considered process work (e.g. test execution or library version control work), the project-type work will be the main focus of this research effort.

2.8 Conflicting Goals

Like in-house software developments, software projects that involve outsourcing require balancing the often-conflicting goals of low cost, high quality/reliability, and speedy development. As noted above, these goals represent a subset of outsourcing motivations. For most domains, cost overruns and schedule slippages are commonplace (Putnam and Myers).

In addition to project goals, different goals for developers versus customers are magnified under a contractual relationship. While in-house developers and users share some common upper management, the same is not true for outsourcing relationships.

2.9 Need for Research

While many published ideas for managing software outsourcing projects appeal to practitioners, it is not clear whether these guidelines are applicable to all project domains and outsourcing strategies. Researchers have also not shown how types of outsourcing strategies affect project consequences. For these reasons, this research effort was undertaken to fill the voids in our understanding of software outsourcing.

This research effort matched successful outsourcing strategies with project constraints and goals rather than outline steps to make any outsourcing relationship satisfactory. The latter topic has been well covered in recent literature as outlined in earlier in this chapter. The overall research picture can be seen in Figure 10. The core effort of this research is focused on determining how product level outsourcing strategies and domain factors impact outsourcing consequences. In addition, customer and supplier characteristics, relationship management policies, and project and product characteristics will be studied to measure their interplay with outsourcing strategies and consequences.

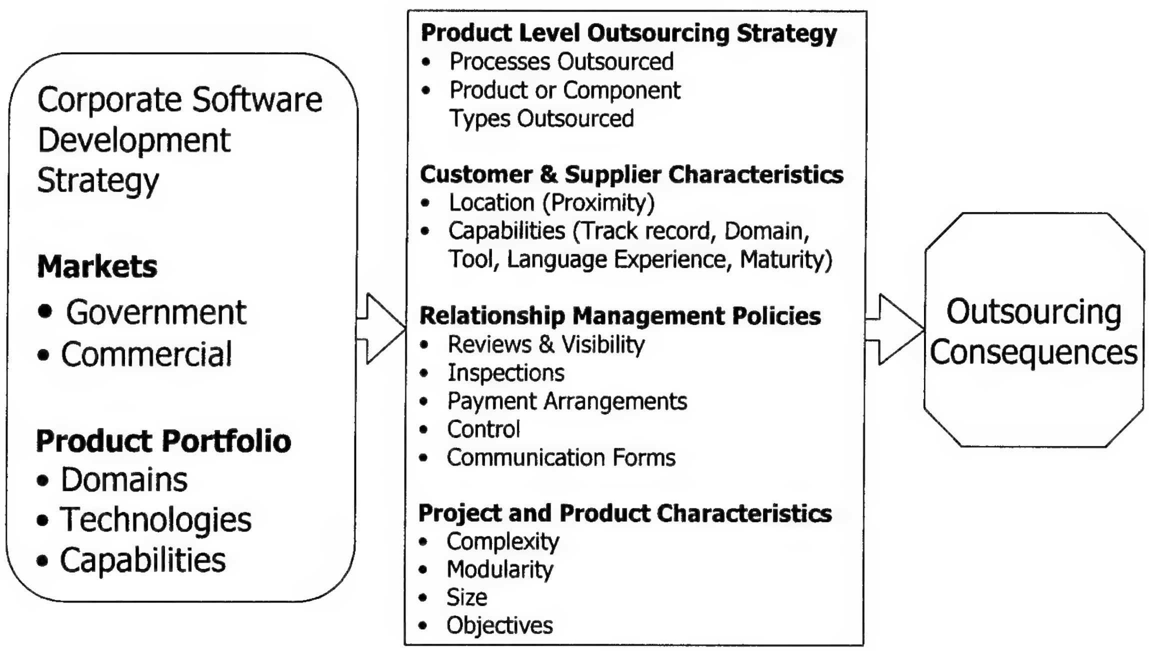


Figure 10: A Hypothetical Model of Software Outsourcing

3. Research Methodology

Given the lack of clear guidelines on outsourcing, a three-phased research effort was undertaken to clarify outsourcing strategy types, motivations, success and failure experiences, and to produce a decision support tool for selecting appropriate outsourcing strategies. This chapter outlines the research effort tasks and their relationships with specific research goals. Section 3.1 summarizes the industry survey design, followed by specific data analyses in Section 3.2, and ultimately the resulting decision support tool and validation effort as discussed in Section 3.3.

3.1 Phase One – Industry Survey

The first task after the initial literature review was to develop a survey questionnaire and locate potential respondents. Special care was taken to minimize the amount of required respondent writing and limit the response scales to appropriate levels of significance and comprehension. The questionnaire employed Likert response scales and limited granularity to seven levels of differentiation per psychological research (Miller). The entire survey instrument is included as Appendix C. Once completed, the survey was pre-tested on Arizona State University Computer Science and Engineering Department graduate students to refine the instrument and identify additional outsourcing contacts. These pre-test responses were not included in the final data anlysis.

Industry software project personnel were asked to characterize their outsourcing experiences based on strategy, project scenarios, goals, and project success. Specifically, the survey asked respondents to identify project scenarios where each outsourcing strategy is likely to succeed or fail. In addition to strategies, the project variables were

collected via survey to determine their impact on success or failure of an outsourcing project. The survey results were statistically correlated with goal success and failure to create dependable heuristic rules and answer the research goals identified in Chapter 1 and discussed below.

3.1.1 Determine the different types of software outsourcing

The literature provides examples of a few outsourcing strategy types such as offshore coding, reengineering, and total acquisition (Watanabe ; Thomsett "Outsourcing: The Great Debate" ; Yourdon). This research effort included a broad survey to determine as many in-use strategies as possible was the first step to creating a framework. The survey results identified many undocumented, in-use strategies filling part of the continuum proposed in the proposed definition of outsourcing.

3.1.2 Determine motivations for software outsourcing

While not necessarily generalizable to the global software industry, survey respondents identified many motivations for software outsourcing that extend beyond those commonly published. These motivations also serve as organizational goals – which are required to determine whether a particular outsourcing strategy is successful.

3.1.3 Establish the benefits and drawbacks of each type of outsourcing

The correlation of goals (motivations), their success or failure, and particular outsourcing strategies resulted in expert information or rules that helps clarify when strategies are appropriate. These rules will become the basis for an expert system.

3.2 Phase Two – Survey Analysis and Framework Construction

The purpose of phase two was to combine the outsourcing experience information and the taxonomy structure information to complete and refine the proposed multi-dimensional framework.

3.2.1 Survey Demographics and Outsourcing Levels

The first and simplest analyses were straightforward histograms and summary information detailing the current levels of outsourcing, amount of experience for each respondent, respondents' outsourcing roles, and software domains included in the survey. All non-blank responses were used in the analysis.

3.2.2 Decision Maker Roles

Responses to Question 11 from the survey were analyzed graphically using histograms to determine which positions or roles have the greatest impact on the success or failure of an outsourcing project.

3.2.3 Outsourcing Goals

Statistical analysis of the respondents' outsourcing goals indicated both the level of importance and satisfaction for each goal in Question nine from the survey.

3.2.4 Analysis of software outsourcing strategies

A software outsourcing strategy is the combination of product and process components outsourced for a particular project. The researcher found many strategy factors to be strongly related to the outsourcing consequences listed in Question 10 of the survey instrument.

3.2.4.1 Product Components Outsourced

Products were categorized as either custom, common off-the-shelf applications, or customized versions of common applications. These distinctions are important because they identify pure custom work, pure supplier work, and hybrid software development requirements.

3.2.4.2 Process Components Outsourced

While the many types of product components are a vast set, process components are fairly well understood from the software engineering literature. Question seven from the survey delineates the processes and respondents indicated whether they have outsourced each individual process. The processes were later subdivided into core processes, necessary for the transformation of requirements to functional software, and support processes that when outsourced reduce in-house workload. Analysis consisted of histograms to determine which processes and combinations of processes are frequently outsourced. The combinations of processes will also be reviewed to determine if they constitute process-only outsourcing, product-only outsourcing, or a hybrid approach. All of these factors were later used as independent variables in the statistical analysis to find outsourcing rules for the decision support tool.

3.2.5 Capturing Framework Rules

Two techniques were proposed and attemped to capture the framework rules from the survey data. First, tools were used to train neural networks to predict outsourcing consequences based on the independent scenario variables. Two problems were found

with this technique. First, defining the proper topology for neural networks is not well-defined (Russell and Norvvig). While some high-level guidelines concerning the number of neural network layers are understood, extensive data is required for the cross-validation necessary to demonstrate that a proper network topology has been selected. Because of these uncertainties and the amount of data required, the second technique was selected.

The statistical regression runs to determine which project strategy variables describe the consequence of software outsourcing projects were the most important parts of the analysis. All process components, product component types, software domains, and strategy factors were considered as possible independent variables in a step-wise linear regression for each outsourcing consequence. The step-wise technique was selected since it ensures that variables selected for the model met the standard 95 percent confidence level criteria. Alternative models were produced using forward, backward, and removal techniques, but all had the same failing. In the alternative regression models performed well and explained most of the variance for each consequence but included many statistically insignificant inputs. This downfall would have given a false sense of security to decision support tool users.

3.2.6 Distill Qualitative Outsourcing Assertions

The means of outsourcing assertions were statisctically compared to values from the response scale to yield the suggestions that form the second half of the decision support tool. Many of these assertions (found in the survey instrument show in Appendix C) came from published outsourcing literature.

3.3 Phase Three – Decision Support Tool Construction and Validation

Once the outsourcing rules and assertions were produced, they were included in a decision support tool. This tool, meant as a prototype, contains the knowledge captured from survey data and is suitable for use as a means of better understanding how outsourcing strategies and scenarios affect the outcomes or consequences of a software outsourcing project.

3.4 Methodology Summary

This chapter explained how the research effort was organized to meet the research goals identified in Chapter one and shown to be lacking in current literature in Chapter two. Chapter four will detail the implementation of this methodology specifically focusing on the survey results and analyses that form the basis for the outsourcing strategy framework and decision support tool.

4. Survey Results

The initial survey was originally conceived to establish a "state of the practice" for software development outsourcing. This type of data is not available in the 'anecdotal' software outsourcing literature (Dedene and DeVreese ; C. Jones "Marry in Haste, Repent at Leisure: Successful Outsourcing Requires Careful Consideration and Preparation" ; C. Jones "Conflict and Litigation between Software Clients and Developers" ; Kaner ; Opperthauser ; Thomsett "Outsourcing: The Great Debate" ; Thomsett "Software Development Outsourcing" ; Yourdon, Rubin and Mohnot ; Yourdon). The survey scope was eventually expanded to include specific project-related outsourcing data. In addition to establishing the state of software development outsourcing, this analysis was intended to produce the basic rules for guiding software developers' outsourcing strategies.

This chapter begins with a discussion of survey sampling and extensibility. Section 4.3 provides a high-level analysis which establishes the current levels and types of outsourcing and their results. Section 4.4 through 4.7 continue this surface-level analysis describing decision maker roles and detailed analysis of current outsourcing strategies. Sections 4.8 and 4.9 present a correlation analysis that provides specific outsourcing "rules of thumb" from the survey data.

4.1 Responses and Sampling

This survey was distributed worldwide to the individuals, groups, and organizations shown in Table 6. A total of 87 responses were received and included in the analysis. A total of 320 paper surveys were sent to Arizona-based software

developers. 24 negative replies were received including several organizations that stated they had tried outsourcing and would never use it again. Negative replies were not included in the results.

Group or Organization	**Distribution Method**
All active and 'emerging' software process improvement network (SPIN) groups in the world	E-Mail
Phoenix SPIN	Research proposal presentation and direct hand-out of surveys
Arizona-based software developers	Standard Mail (Initial and Follow-up)
Board members of the Arizona Software Association (now called the Arizona Software and Internet Association or AZSOFT.net)	Both Standard and Electronic Mail
DoD Software Developers	Notice in *Crosstalk* – The Defense Journal of Software Engineering
ACM Special Interest Group on Software Engineering (SIGSOFT)	Notice in *Software Engineering Notes*
Selected Industry Contacts	E-Mail
Software Engineering Newsgroup (comp.software-eng)	Electronic Posting

Table 6: Survey Respondents and Methods of Contact

Sampling for this survey was not traditional random sampling from a known population. Within the state of Arizona, every known software development organization was sent a survey packet. A follow-up packet was resent to organizations that did not respond to the initial mailing. Each SPIN group, personal industry contacts, and software engineering newsgroup readers were invited to take the survey via e-mail, web-based survey, or the paper-based questionnaire.

4.2 Extensibility

Several extensibility concerns exist for these results. Because the sample size (87) is significantly smaller than the approximate population size of the software

industry, the sample can be considered random (Devore). Unfortunately, this assumption of randomness overlooks the fact that 50 percent of the responses come from the state of Arizona alone. While this does not invalidate the research, one must be careful to remember the results may be based upon market influences that may differ elsewhere. To an extent, this problem is balanced by the remaining survey responses coming from other parts of the United States and international software organizations. Nevertheless, the focus was primarily on United States organizations.

4.3 Demographics

4.3.1 Outsourcing Experience

The respondents as a group averaged just over five outsourcing project experiences with the vast majority of respondents in the zero to five range and remainder making up the more experienced "tail" on the right side of the distribution curve (Table 7 and Figure 11).

	Number of Projects per Respondent	Percent of Outsourcing within Respondent Organization
Mean	5.5132	26.6753
Median	3.0000	10.0000
Mode	2.00	.00
Std. Deviation	7.0569	31.6712

Table 7: Experience and Company Outsourcing Levels

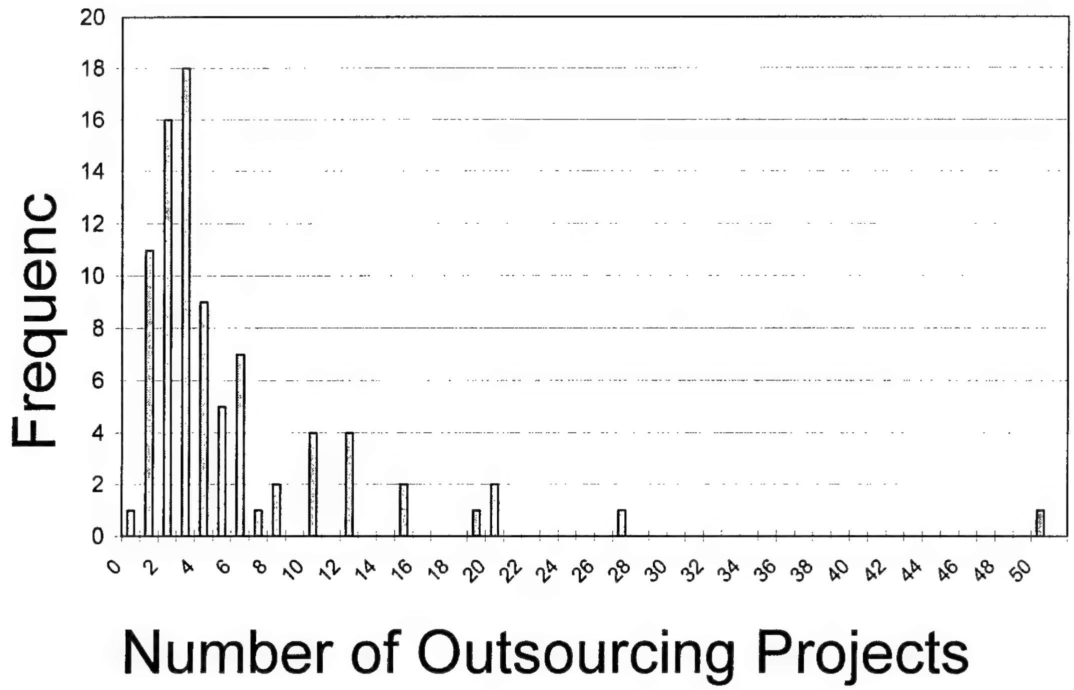


Figure 11: Respondent Experience

4.3.2 Respondent Outsourcing Roles

Many respondents indicated fulfilling several roles during outsourced software development projects. While the survey was sent directly to corporate software development managers, the most frequently noted respondent role was contract officer for the customer organization. The distribution of roles in Figure 12 indicates a good mix of customer and vendor responses. Sixty-seven of the respondents identified themselves as part of the customer organization while fifteen identified themselves as members of vendor organizations.

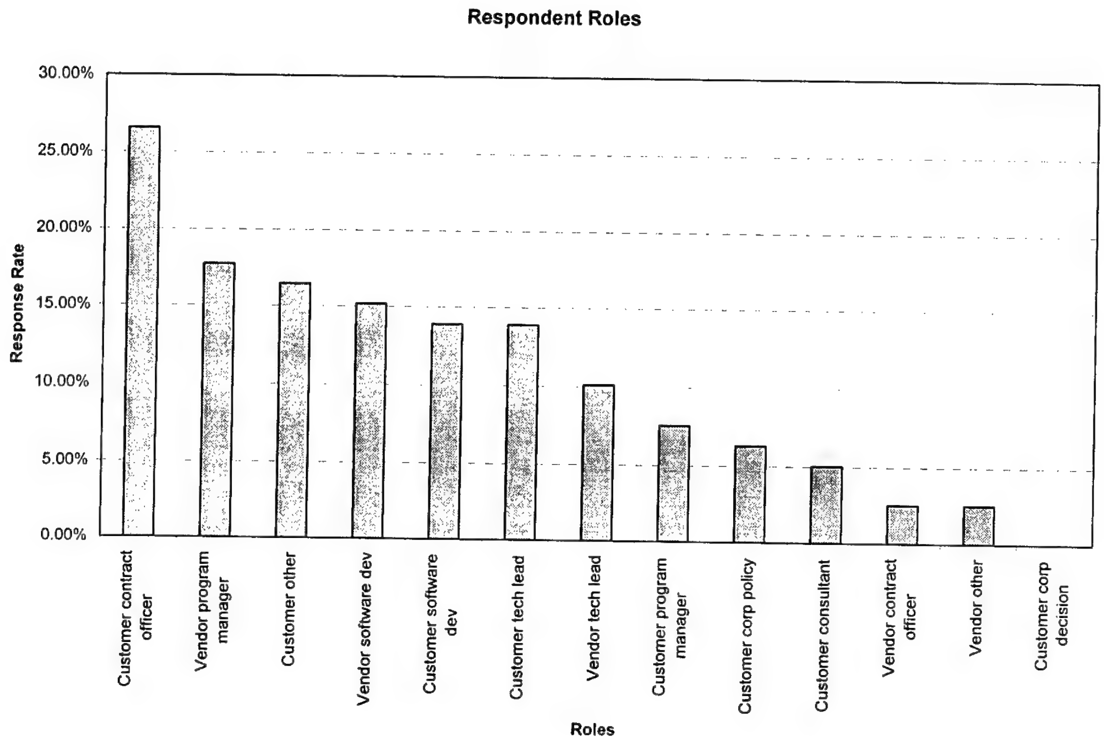


Figure 12: Respondent Outsourcing Roles

4.3.3 Company Outsourcing Levels

Table 7 shows the levels of software outsourcing in the respondents' organizations. This distribution is also pictured in Figure 13. Most respondents' organizations outsource approximately ten percent of their software development effort. Several organizations outsource more than fifty percent of their development effort, raising the mean to more than twenty-five percent.

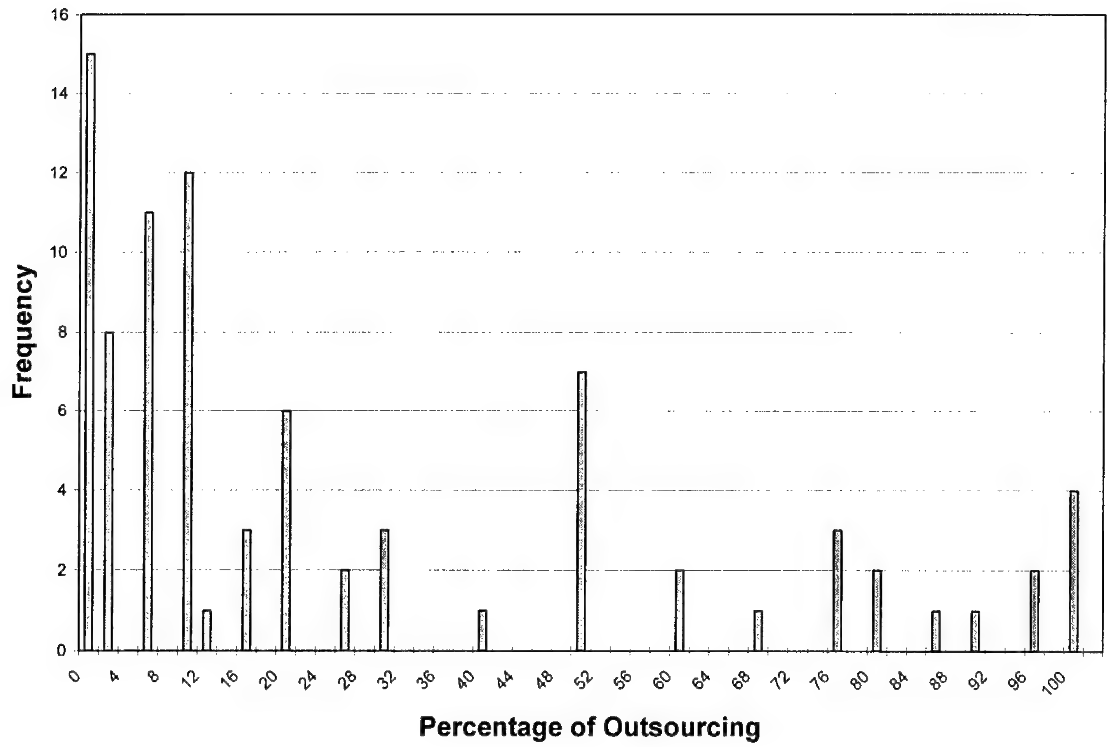


Figure 13: Levels of Outsourcing

4.3.4 Domain Coverage

The organizations represented by the 87 survey respondents included all of the four major software domains shown in Table 8. These categories were gleaned from several sources including Capers Jones' text on programmer productivity (C. Jones Programming Productivity). While most companies identified working in several sub-categories within their domain, the majority were associated with a single major domain (Figure 14). The fact that some organizations work in multiple domains explains why the numbers in columns two and three of Table 8 do not sum to 87 and 100 percent respectively.

	N	Percent
Systems Software	49	56%
Enterprise Software Development	45	52%
Shrink Wrap (Commercial/Consumer Software)	32	37%
Software Component Development	31	36%

Table 8: Software Domains Represented in the Initial Survey

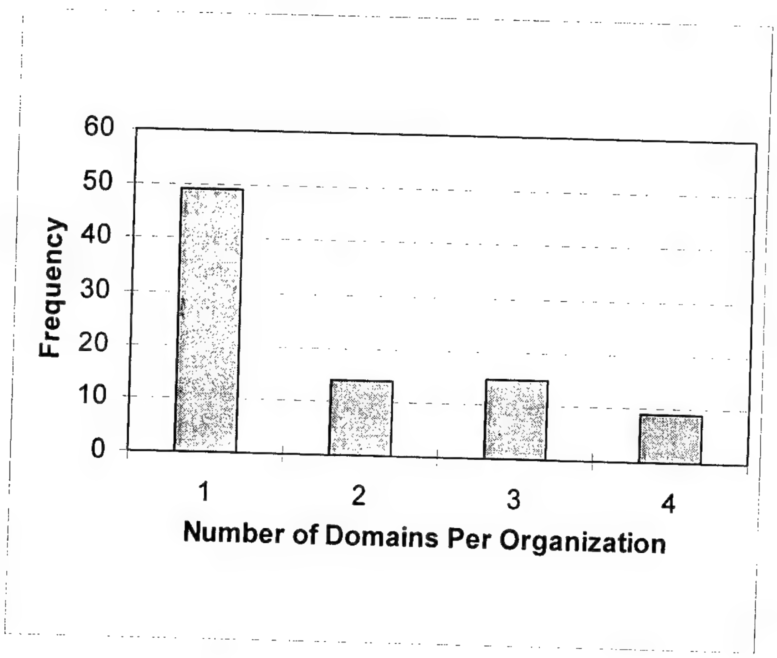


Figure 14: Major Domains within Each Organization

4.4 Decision Maker Roles

Figure 15 shows the roles that most strongly influence outsourcing decisions on software development projects. As expected, project manager and technical lead roles typically craft outsourcing arrangements. Frequently respondents included corporate policies and decisions as the driving force in outsourcing decisions. This underscores the strategic nature of many outsourcing decisions. Respondents clearly identified vendor

project managers as the only strong influence from the vendor side of the outsourcing relationship (Figure 16).

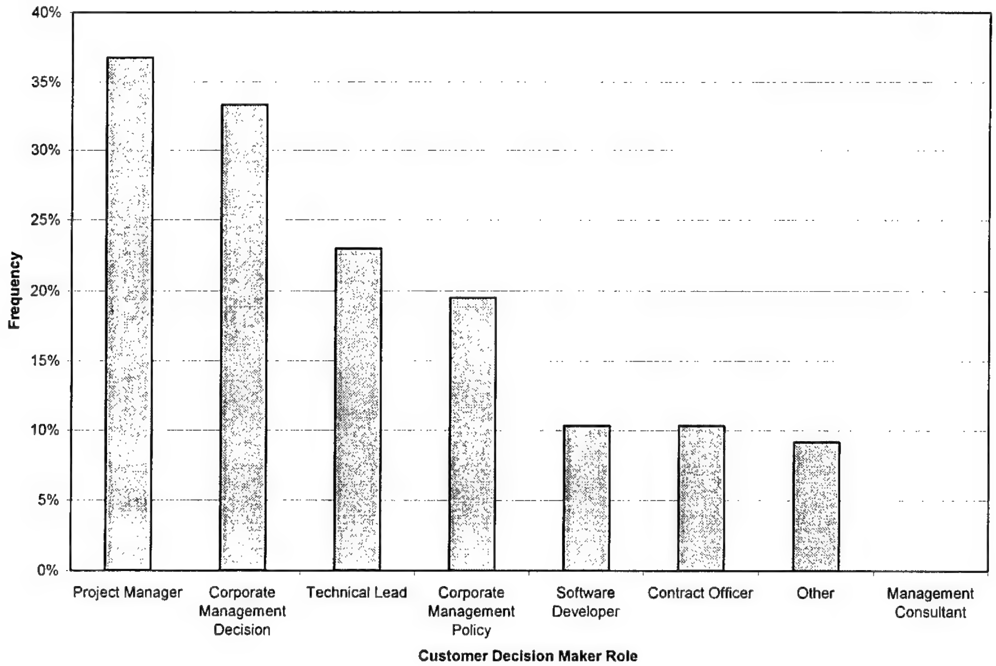


Figure 15: Outsourcing Decision-Maker Roles in the Customer Organization

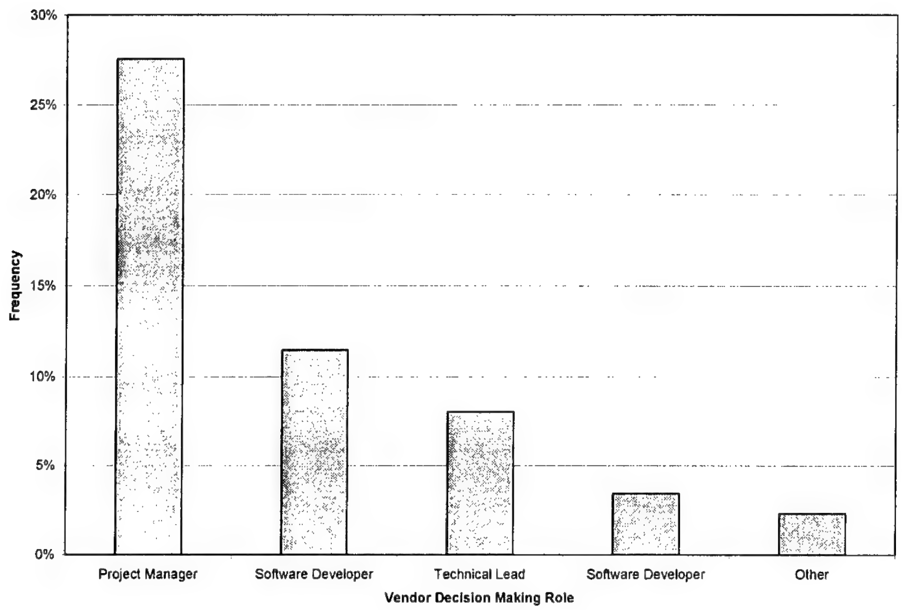


Figure 16: Outsourcing Decision-Maker Roles in the Vendor Organization

The key outsourcing decision makers for each project are indicated in Figure 17. As expected, customer program managers lead the ranks of decision makers, but the vendor program managers also appear to have a significant hand in determining the outsourcing relationship.

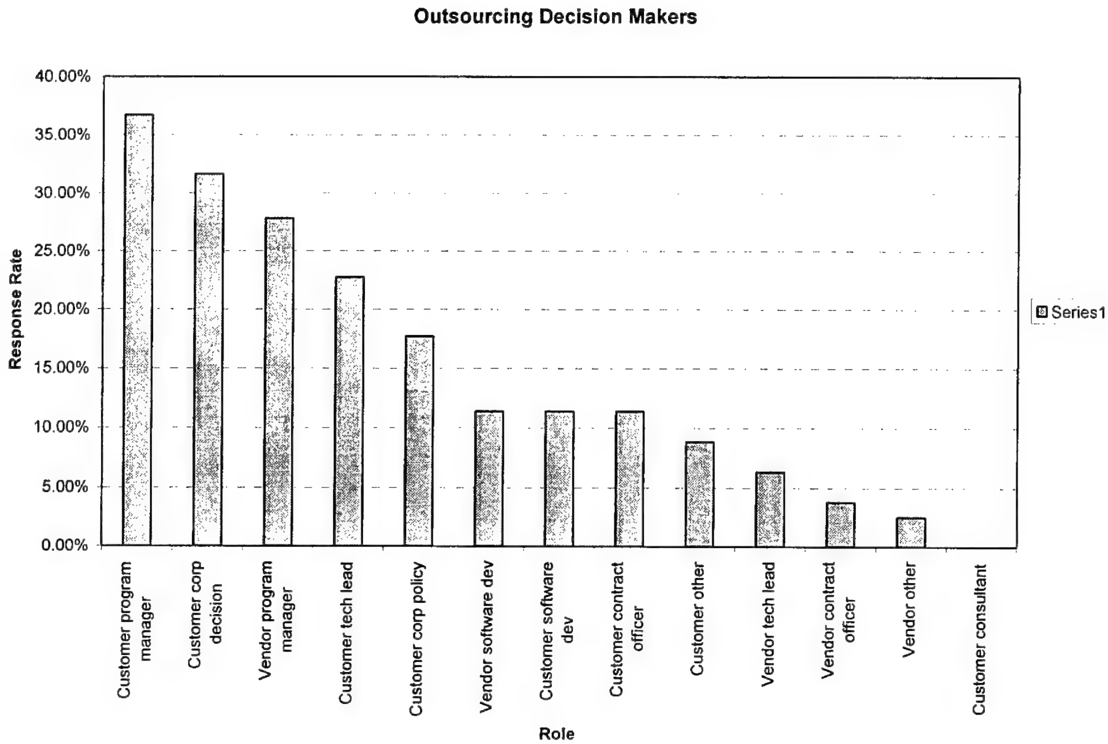


Figure 17: Outsourcing Decision Making Roles

4.5 Product Component Types Outsourced

Outsourced products where characterized as either customized common applications, common applications (COTS), or completely custom work. Figure 18 shows general categories of outsourced software products identified in the survey. Clearly custom development represents the majority of respondents' outsourced software products. The prevalence of outsourcing custom software development indicates that developers look to vendors with domain experience and products that can be tailored for a project's needs.

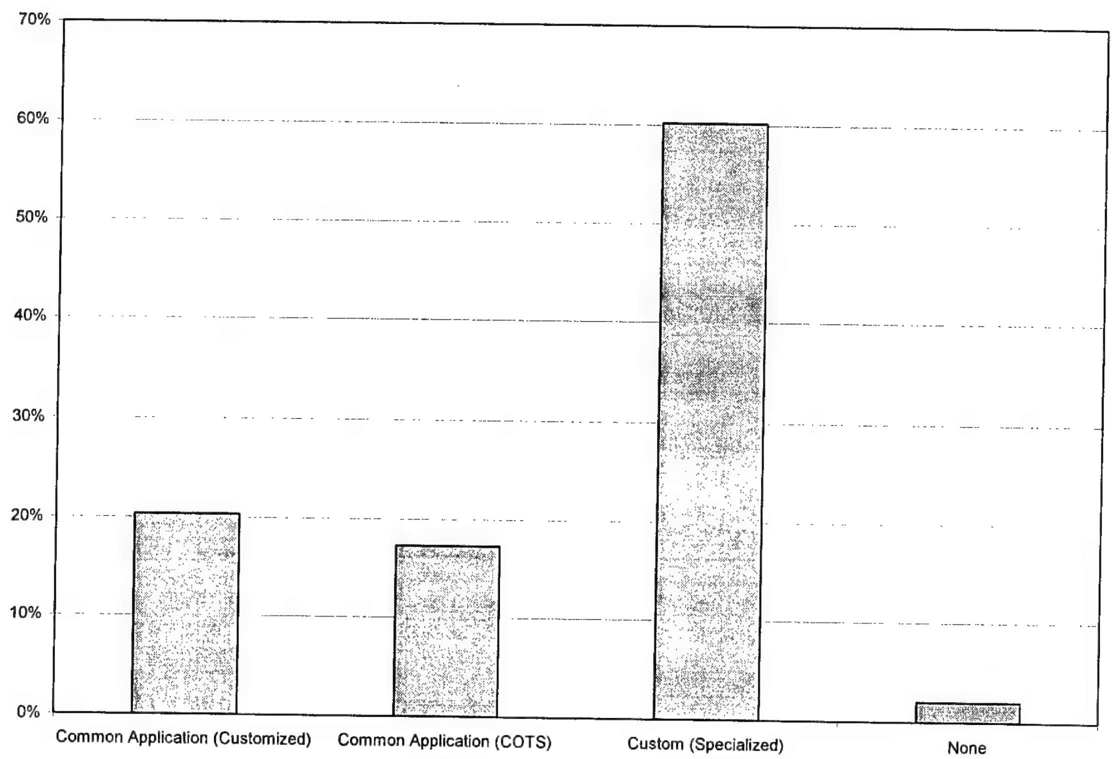


Figure 18: Types of Outsourced Software Products

4.6 Process Components Outsourced

Whether outsourcing product components or processes, respondents indicated which processes the outsourcing vendors performed or supported. Figure 19 shows the percentage of respondents who indicated their organization outsourced particular processes components.

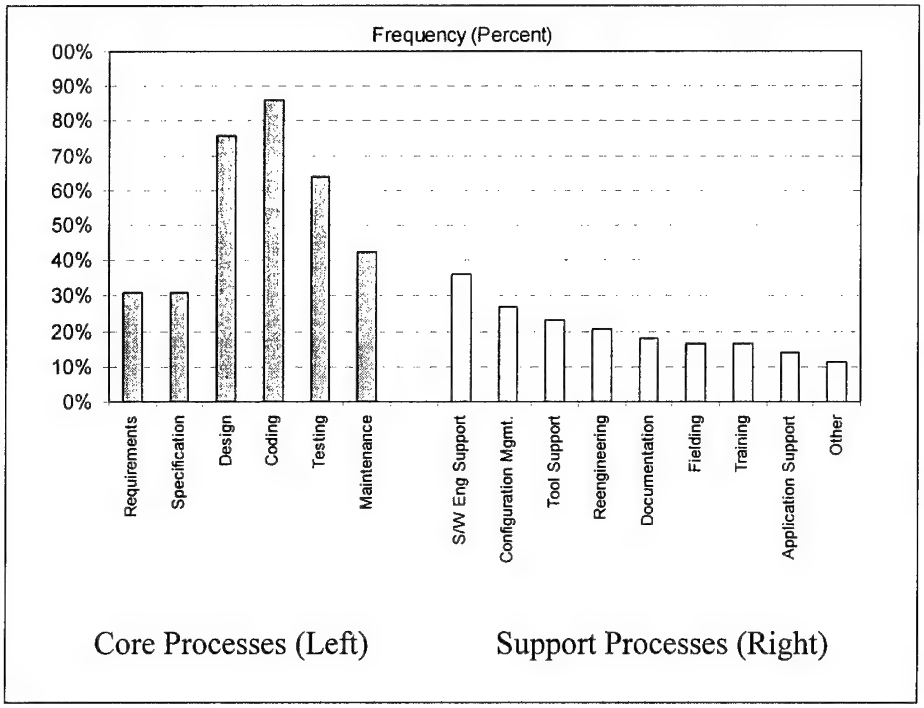


Figure 19: Relative Frequency of Outsourced Software Development Processes

4.7 Outsourcing Strategies

One of the key objectives of this research was to determine how software developers organize for outsourcing. This information begins with the responses to the initial survey's questions about which development processes were outsourced. The individual processes listed were later subdivided into 'core' and 'support' processes. A company's strategy is considered product outsourcing if the organization outsources at least design and coding from the set of core processes (requirements, specification, design, coding, testing, and maintenance). This definition of product outsourcing is defensible since product outsourcing typically involves transforming a customer's requirements into a product component. Design and coding actually accomplish that transformation leaving integration and testing responsibilities as a separate strategy

decision. Outsourcing that does not meet the product outsourcing requirement is considered process outsourcing.

As expected, most outsourcing strategies involved some product component outsourcing (Table 10). The amount of process outsourcing from this survey was surprising because process outsourcing is not discussed in typical software outsourcing literature. In fact, many software outsourcing articles begin by discussing the unique project-related aspects of software and information technology outsourcing and how they differ from generic outsourcing (Rubin ; Thomsett "Outsourcing: The Great Debate"). Only a few discuss offshore reengineering efforts or contract maintenance (Rubin ; Watanabe). Neither of these processes truly qualifies as discussions of process outsourcing. Thus realizing that fully 30 percent of all respondent's outsourcing projects involved outsourcing only processes to a vendor appeared incongruous with software outsourcing literature. More than 50 percent of respondents' outsourcing projects consisted of a hybrid process and product component outsourcing strategy. Most respondents indicated that their organization outsourced between two and four core processes and two or fewer support processes (Table 9, Figure 20, and Figure 21). Thus the average outsourcing project included hiring vendors to perform between four and five process components in the software development process.

	CORE	**SUPPORT**
Mean	3.2308	1.5641
Median	3	1

Table 9: Number of Processes Outsourced

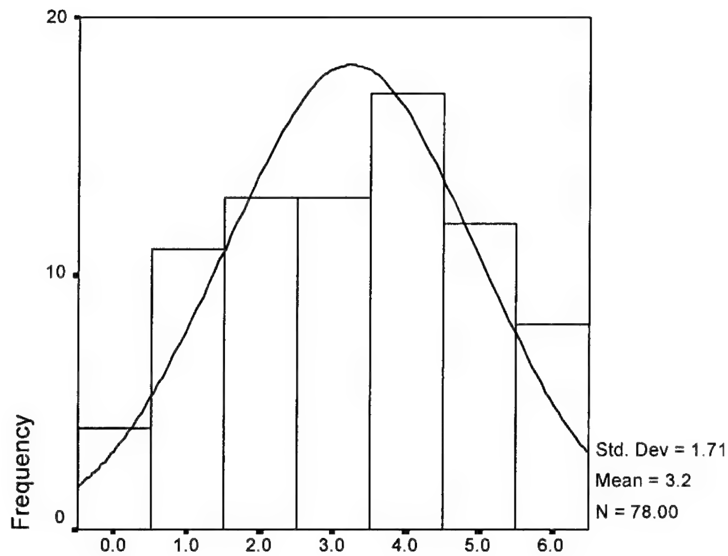


Figure 20: Number of Core Processes Outsourced

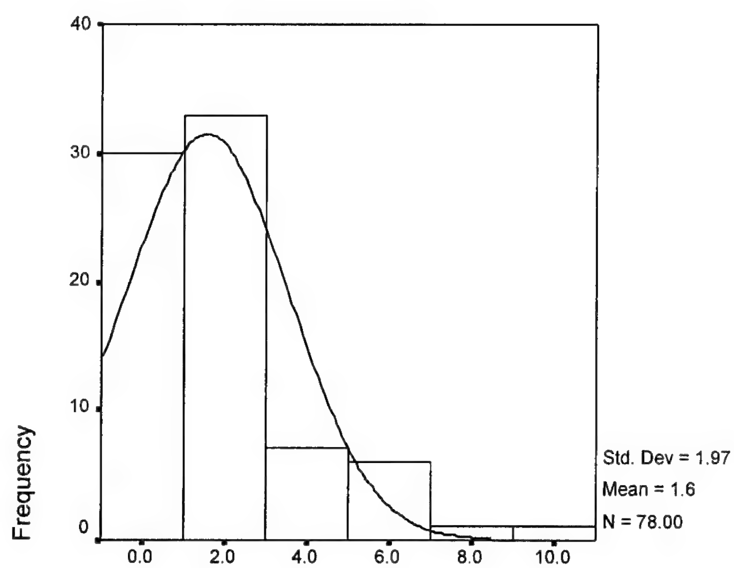


Figure 21: Number of Support Processes Outsourced

	Total	Percent
Product	61	70.1%
Process	71	81.6%
Process Only	26	30%
Product Only	16	18%
Both	45	52%

Table 10: Process versus Product Outsourcing Strategies

4.8 Outsourcing Project Goals

4.8.1 Analysis Techniques

Statistical techniques were used to determine what goals respondents' considered important. The first technique is the T-test. This test compares the sample means to a constant. In this case, goal importance was defined on a five-point scale from "not important" (one) to "very important (two). The scale can be found in question nine of the survey questionnaire. A goal has some level of importance if the sample mean is statistically different (higher) than the value for "not important" (one). While a simple comparison of means gives some indication of the importance, the T-test allows a researcher to make statistical claims. Similarly, the sample mean for each goal can be compared to other values on the response scale to determine if they are considered "somewhat important", "very important", or some other value.

A significant difference between the observed mean and the neutral answer implies that the factor comes from a different population than the neutral answer. The sample size and mean-difference also combine to produce significance values that indicate how confident the researcher can be about the level of difference. To complete the analysis, the Bonferroni correction was used to calculate the actual levels of

significance and confidence intervals. The Bonferroni correction eliminates the possibility of finding significant differences between several sample variables by chance alone (SPSS Inc.). In this technique, the alpha level is divided by the number of variables included in a one-sample T-test. For example, if a 99 percent confidence level is necessary when conducting one-sample T-test on 22 variables, a researcher would adjust the significance as follows:

$$\alpha = .01$$
$$\text{Bonferroni corrected } \alpha_{bc} = \alpha / \text{number of variables} = .01/22$$
$$\text{Bonferroni Corrected Significance} = 1 - \alpha_{bc} = 0.999545$$

Thus simultaneous one-sample T-tests on 22 variables can achieve a 99 percent confidence level when the analyses are conducted using the tighter 99.9545 percent bonferroni confidence level.

Similar analysis will be used to determine the degree to which these goals were realized for respondents' outsourcing projects. This "degree of realization" will not become part of the decision support tool since it is dependent on the importance and aggressiveness of each goal. The consequences, however, are completely described by the seven-point schedule in question ten of the questionnaire.

4.8.2 Importance

Question nine in the survey asked respondents to rate the importance of several outsourcing motivations. Table 11 shows the motivations in rank order from most important to least important. Using a one-sample T-test, each mean was compared to one (the value for "not important"). Each motivation passed this test at the 95% confidence

level. Success at the 95% confidence level indicates respondents believed each goal was something more than "not important." Another T-test comparing the sample means to three, the value for "somewhat important," shows that keeping stable staffing levels, sharing risks with outsourcing vendors, and improving cash flow are considered significantly less than "somewhat important."

Goal	**Importance**
Acquire Expertise not Available In-house	3.61
Reduce Schedule (Vendor Faster)	3.30
Improve Responsiveness to Organizational Objectives	3.29
Improve Responsiveness to Customer Objectives	3.21
Add People (insufficient in-house capacity)	3.15
Improve Product Quality	3.10
Reduce Schedule (through parallel activities)	3.06
Improve Control over Project Management	2.75
Non-Core Activities	2.63
Add People (short-term)	2.54
Reduce Cost (via economies of scale)	2.54
Keep Staffing Levels Stable	2.48
Risk Sharing	2.35
Cash Flow from Sale of Product Rights	1.49

Table 11: Respondents' Outsourcing Motivations

Survey respondents identified several other outsourcing goals not included in the original questionnaire. Most of these goals can be considered restatements of goals from the survey or variations on the same theme. First, three respondent organizations expected to use outsourcing to improve development processes and standards. Each respondent listed the aim of improving development processes and standards as an important goal, with two not meeting expectations and one significantly better than expectations. Several other responses such as testing potential partner organizations, adding to development team prestige, synergy with other systems, and outsourcing as a

development strategy indicate the long-range implications of outsourcing. Outsourcing to meet the expected level of development change traffic, shifting blame in the event of project failure, and finding an outsourcing vendor in a specific country are tactical uses of outsourcing at the project level. In the response that indicated a goal of finding a vendor in a specific country, the motivation was not to develop a partnership or improve the project but to meet a requirement to include indigenous vendors in order to win a development contract with that country's government. All of the other goals listed by respondents are shown in Figure 22.

Other Outsourcing Goal	**Number of Respondents**	**Importance**	**Results**
Improve development processes and standards	3	5 4 4	2 5 1
Ability of vendor to handle expected volume of changes	1	5	1
Hiring a vendor of a specific nationality to help win contract with that nation's government.	1	5	4
Field support	1	3	3
Test vendor as potential long-term partner	1	3	3
Achieve knowledge transfer from vendor	1	3	3
Add prestige to development team	1	4	4
Realize synergy with other systems	1	4	3
Shift blame to vendor for potential project failure	1	5	2
Part of development strategy	1	4	2
Effectiveness of overall project	1	4	4
Project magnitude too large for single organization	1	5	4
Help field new system	1	5	1

Figure 22: Other Outsourcing Goals

4.8.3 Degree of Goal Realization

Respondents were asked to estimate the degree to which their outsourcing goals were realized for the subject project. The responses were based on a five point Likert scale shown in Table 12.

Significantly Worse than Expectations		Exactly on Target		Significantly Better than Expectations
1	2	3	4	5

Table 12: Five-Point Goal Realization Scale

Table 13 shows the results of respondents outsourcing projects in terms of 14 outsourcing goals. The results are presented in three forms. First, the table is divided into shaded and un-shaded goals. The shaded goals (first nine rows in Table 13) have means that, according to a one sample T-test, are not significantly different from three (exactly on target). The un-shaded goals are significantly less than exactly on target and thus do not typically meet respondents' expectations or targets. Second, the middle column shows the numerical mean of responses for each goal. Finally, the third column shows the percentage of responses that were positive. In this case, positive is defined as greater than or equal to three since three is defined as "exactly on target" in the response scale shown in Table 12. Positive responses indicate the goal result was equal to or better than expectations or targets. The relatively high percentage of positive results and strong central tendencies indicate a tail of negative responses lowering the mean result for most goals.

Goal	Result Mean	Percentage of Positive Responses
Acquire Expertise not Available In-house	3.14	79%
Non-Core Activities	3.08	83%
Add People (insufficient in-house capacity)	3.06	81%
Add People (short-term)	2.93	83%
Keep Staffing Levels Stable	2.93	83%
Improve Responsiveness to Organizational Objectives	2.71	62%
Improve Responsiveness to Customer Objectives	2.65	59%
Risk Sharing	2.65	67%
Improve Product Quality	2.63	66%
Cash Flow from Sale of Product Rights	2.70	74%
Reduce Schedule (through parallel activities)	2.54	43%
Improve Control over Project Management	2.54	57%
Reduce Cost (via economies of scale)	2.54	57%
Reduce Schedule (Vendor Faster)	2.42	48%

Table 13: Results of Outsourcing Goals

It is clear from the low averages and significant percentages of negative responses shown in Table 13 that outsourcing frequently fails to meet schedule reduction goals. Although most respondents indicated meeting or exceeding cost reduction and control over project management goals, a significant percentage of respondents experienced poor results in these areas.

4.8.4 Prediction of Goal Realization

The survey data was analyzed using regression models and neural network techniques to determine which strategy variables can be suggested as predictors for a project's ability to meet outsourcing goals.

Potential inputs to each regression model included the processes outsourced, software domains, and products outsourced. Each goal outcome was subjected to a step-wise linear regression to ensure only significant factors were selected for each rule. The

resulting amounts of variance explained, R Square, are lower than originally expected because of the choice of using stepwise regression rather than simply entering each possible factor into the regression model. The latter choice would, however, produce models explaining a high percentage of the dependent variable's variance but with potentially flawed input from statistically insignificant factors. A standard 95 percent confidence level was chosen to accept a variable into the model at each step with a corresponding 90 confidence required to subsequently remove factors (Devore). Complete listings of these regression statistics are shown in Appendix B.

The following sections will describe the regression results for each goal and require some explanation. Items on the left side of each diagram represent the statistically significant factors that affect the project goals (shown on the right side of each diagram). On the left side of each diagram, domain factors are shown in rectangles with rounded corners, process factors are shown in plain rectangles, and product factors are rectangles with curved lines on the bottom. Outsourcing goals and consequences are shown alone on the right side of each diagram. The lines between factors and goals represent the relationships and are annotated with either a plus or minus sign. The sign represents the direction the factor impacts its related goal. For example, the minus sign in Figure 23 indicates that projects in the systems sub-domain of device drivers correspond with a reduced ability to meet their product quality improvement goals.

4.8.4.1 Product Quality

The first regression analysis yielded a model to predict a project's ability to meet product quality improvement goals. While the model only explains a small amount of

variance it is interesting to note both the regression constant factor and the software domain influence. The constant (2.729) suggests product quality improvement is nearly on-target. The only significant factor was that outsourcing projects within the device driver sub domain correlates with a significant reduction in ability to meet quality improvement expectations (Figure 23).

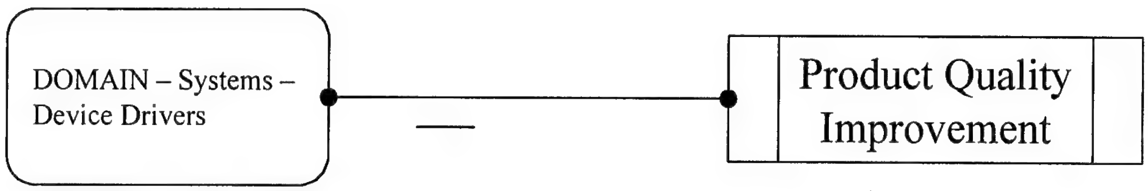


Figure 23: Factor Associated with Likelihood of Meeting Product Quality Improvement Goals

4.8.4.2 Non-Core Activities

Most respondent outsourcing strategies resulted in meeting organizational targets for outsourcing non-core activities. Only device drivers and COTS projects were significantly correlated with a reduction in the ability to meet goals of offloading non-core effort (Figure 24).

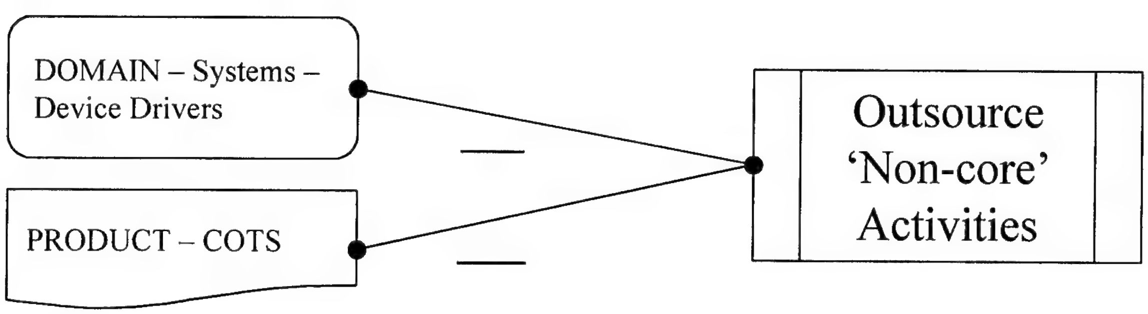


Figure 24: Factors Associated with Likelihood of Meeting Offloading of Non-Core Activities Goals

4.8.4.3 Acquire Outside Expertise

Respondents identified acquiring expertise not available in-house as the most important goal for outsourcing software developments. The predictors for the result of this important goal include positive correlation with projects in the systems domain and those that include outsourcing the reengineering process (Figure 25). Projects in the commercial (shrink-wrap) Internet sub domain have significant negative correlation with decreased ability to acquire outside expertise. These factors indicate that respondents in the systems domain have been better able to find outside expertise than the commercial Internet sub domain—perhaps because of a scarcity of Internet expertise or demand for such talent.

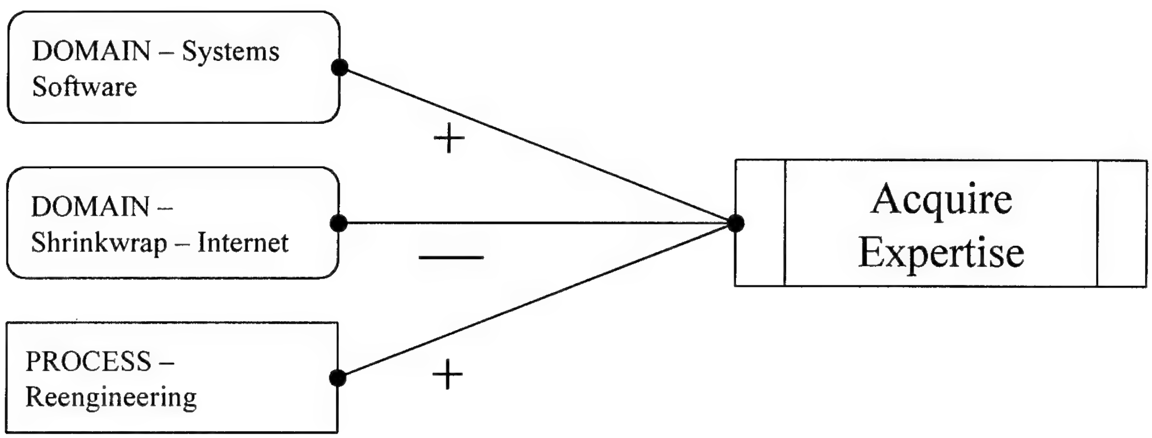


Figure 25: Factors Associated with Likelihood of Meeting Goals of Acquiring Outside Expertise

4.8.4.4 Control over Outsourced Project Management Process

Researchers suggest some software development is outsourced to take back control over projects that was lost to in-house developers (W. Jones). Respondents indicated this control was "somewhat important." Reengineering efforts seem to enhance

this control while outsourcing the requirements process reduces an organization's ability to meet goals for controlling the development process (Figure 26).

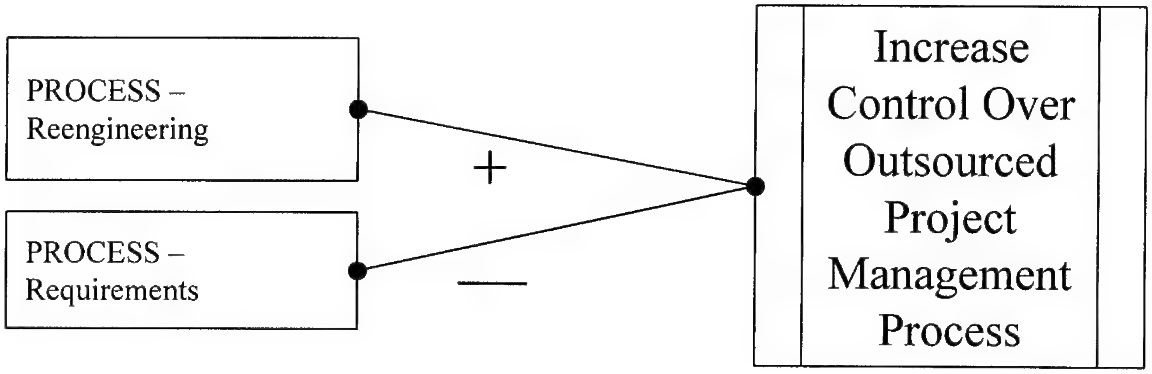


Figure 26: Factors Associated with Likelihood of Meeting Goals to Increase Control Over Outsourced Project Management Process

4.8.4.5 Cash Flow

Respondents clearly indicated outsourcing with the goal of achieving cash flow was unimportant to them. Two negative factors were found to aid in the prediction of meeting goals of cash flow benefits from outsourcing. Device driver projects and interactive web site development projects both correlate with strong reductions in ability to meet cash flow goals (Figure 27).

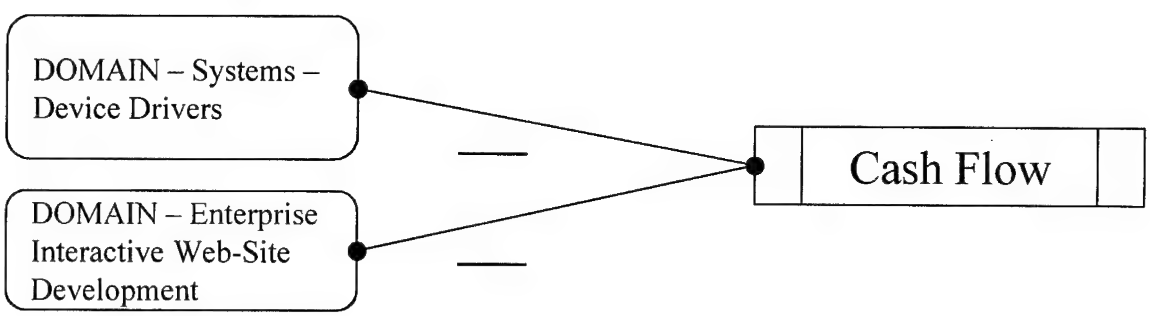


Figure 27: Factors Associated with Achieving Cash Flow Goals

4.8.4.6 Add More Personnel (Insufficient In-House Capacity)

At the 95 percent confidence level, no significant factors were found to predict the ability to meet the goal of adding more project personnel to overcome insufficient in-house capacity. Not finding any significant influence factors implies that neither domain, product type, nor processes outsourced significantly impact an organization's ability to add more personnel through outsourcing when the in-house capacity is insufficient.

4.8.4.7 Add More Personnel (Short-Term Need)

Adding project personnel because of a short-term need is less important to respondents than adding due to insufficient in-house capacity. The types of products and projects involved in the outsourcing, however, significantly impact it (Figure 28). Customization of common applications appears to indicate a reduction in ability to add more personnel for a short term need. In contrast, projects in the accounting system sub domain correlate with an improved ability to add personnel. The positive correlation between projects in the accounting system sub domain and a project's ability to meet goals of adding personnel may represent domain labor availability more than any other aspect of accounting systems.

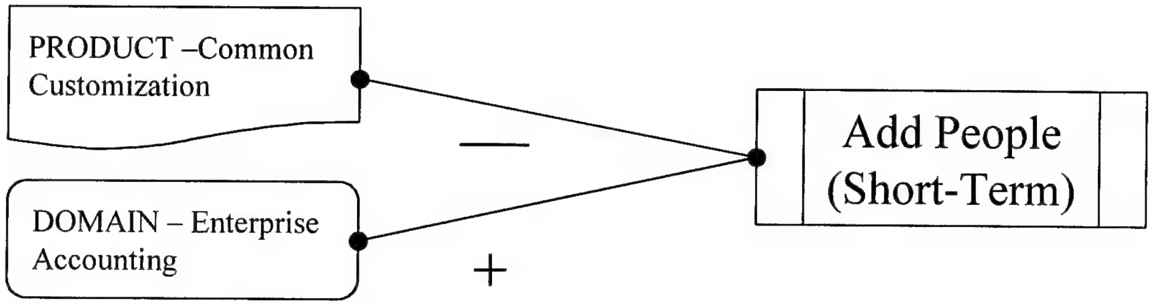


Figure 28: Factors Associated with Achieving Goals for Adding Personnel Due to Short-Term Shortages

4.8.4.8 Responsiveness to Organizational Objectives

Similar to control over the development process, improving responsiveness to organizational objectives was suggested as an outsourcing motivation (Thomsett "Outsourcing: The Great Debate"). Projects in the device driver sub domain indicate reduced ability to improve responsiveness (Figure 29). Outsourcing software engineering support also indicates reduced ability to meet this goal. Finally, outsourcing the coding process correlates with an improved ability to meet this goal.

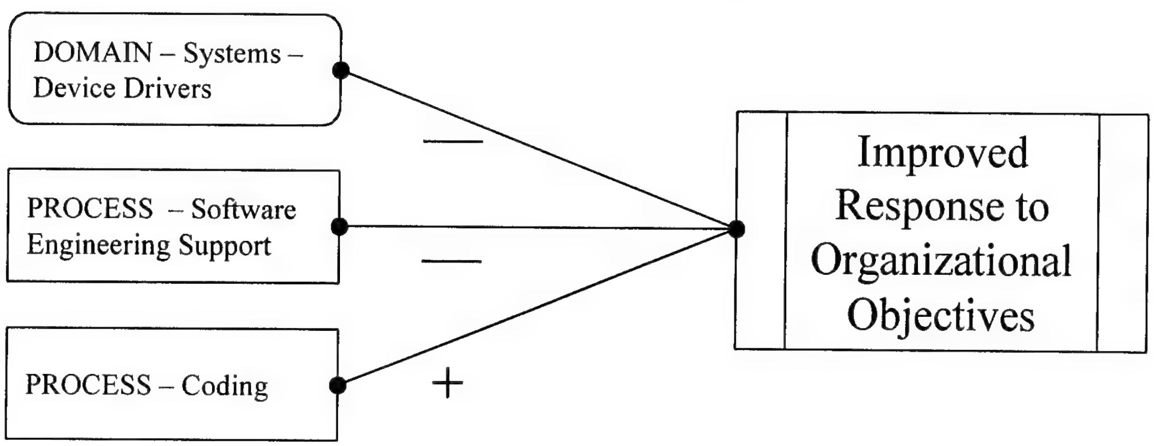


Figure 29: Factors Associated with Meeting Goals of Improving Responsiveness to Organizational Objectives

4.8.4.9 Risk Sharing

While several authors suggest outsourcing as a means of risk sharing, survey respondents indicated this was not a significantly important goal for their outsourcing arrangements. Outsourcing software engineering support was the only significant factor related to an organization's reduced ability to meet risk-sharing goals (Figure 30).

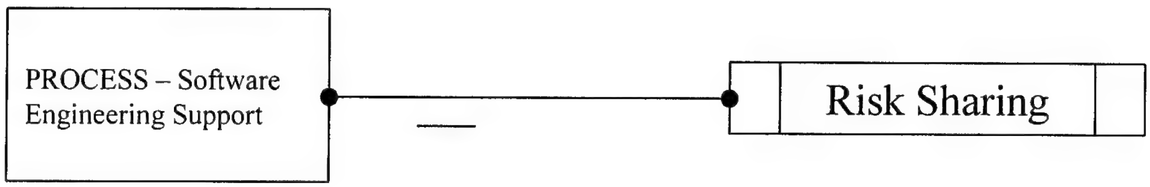


Figure 30: Factor Associated with Ability to Meet Outsourcing Risk Sharing Goals

4.8.4.10 Stable Staffing Levels and Personnel Turnover

Statistical analysis indicates outsourcing only processes (rather than products), maintenance, and reengineering enhance an organization's ability to meet its goal of maintaining stable staffing levels (Figure 31). Outsourcing configuration management, however, correlates to a significant reduction in ability to meet goals of stable staffing levels.

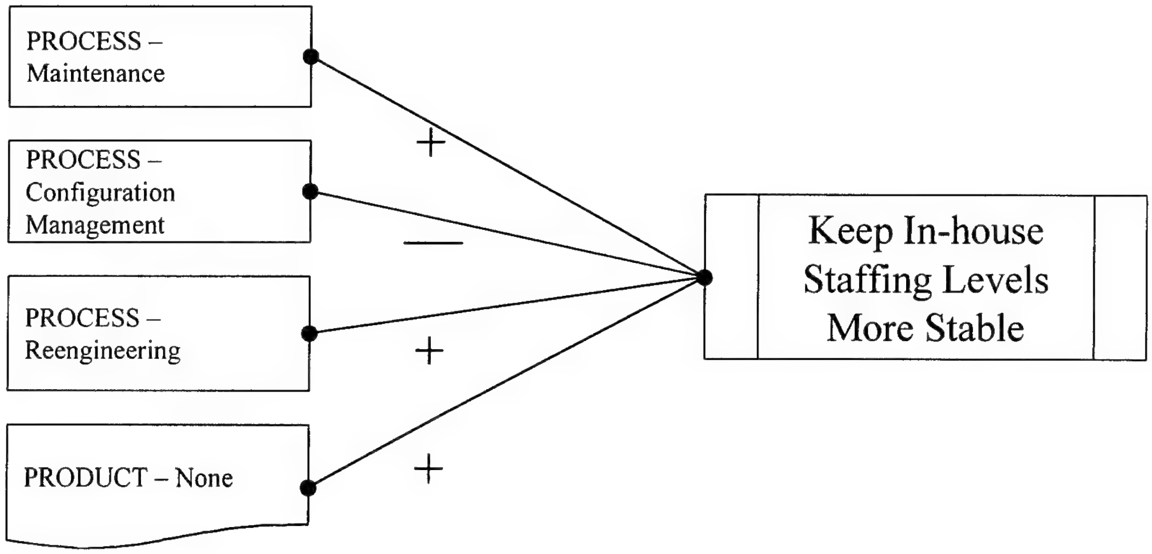


Figure 31: Factors Associated with Meeting Goals of Maintaining Stable In-House Staffing Levels

4.8.4.11 Responsiveness to Customer Objectives

Respondents indicated improved responsiveness to customer objectives is an important motivation for software outsourcing (Section 4.8.2). Outsourcing software engineering support and projects in the device driver sub domain appear to hinder an organization's ability to make this improvement (Figure 32). In contrast, outsourcing in the order entry system and avionics sub domains enhanced an organization's ability to improve responsiveness to their customers.

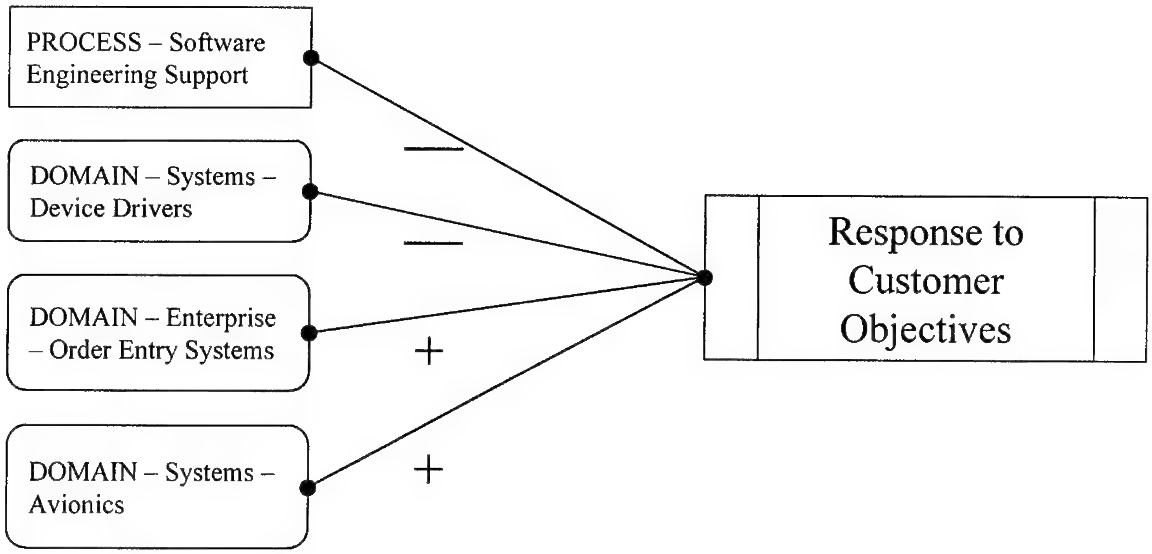


Figure 32: Factors Associated with Ability to Meet Responsiveness to Customer Objective Goals

4.8.4.12 Development Schedule

Respondents clearly showed reduction of development schedule to be an important goal for software outsourcing. When respondents expected to reduce schedule duration due to vendor efficiencies, outsourcing the requirements process enhanced their project's ability to meet this goal (Figure 33). Using outsourcing to increase parallel activities and thus schedule duration was less important and hindered when software engineering support was outsourced and enhanced for projects in the avionics sub domain (Figure 34).

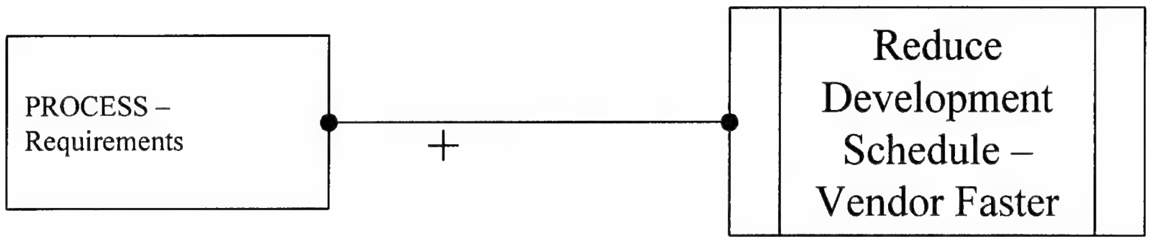


Figure 33: Factor Associated with Ability to Meet Goals of Reducing Development Schedule by Using Faster Vendors

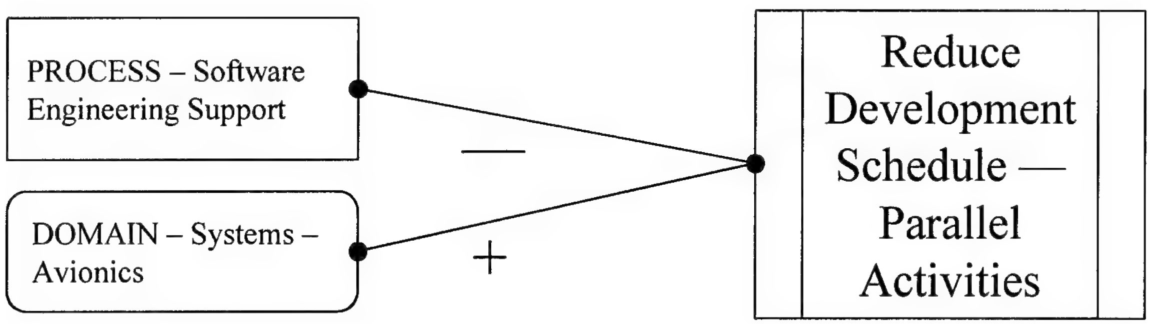


Figure 34: Factors Associated with Ability to Meet Goals of Reducing Development Schedule by Increasing Parallel Activities

4.8.4.13 Project Cost

Respondents placed cost reduction far down their list of outsourcing goals. Outsourcing the fielding process is the only significant factor associated (negatively) with an organization's ability to meet cost reduction goals (Figure 35).

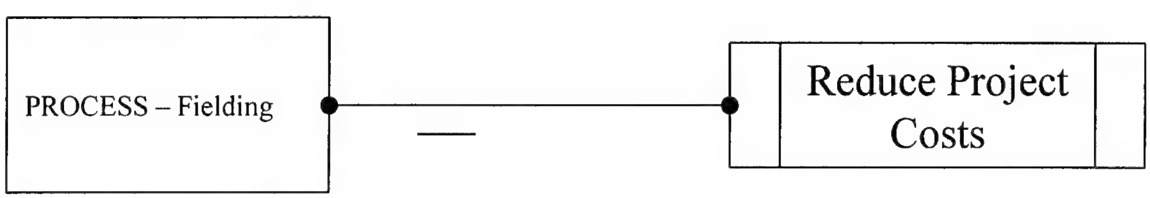


Figure 35: Factor Associated with Meeting Goals of Reducing Project Costs Through Outsourcing

4.8.5 Results

Figure 36 shows the results of outsourcing in terms of specific project goals. Since goal satisfaction is partially dependent on the aggressiveness of the outsourcing goal, relative consequences compared to in-house projects are a better measure of outsourcing performance. The results are not terribly encouraging. Schedule flexibility is the single consequence that improved for more than 50 percent of the outsourced projects (as compared to in-house experiences). When the neutral responses are added, however, the results became somewhat more positive. Using that criterion, only "visibility into the development process" fails to meet or exceed in-house experiences for 50 percent of the outsourced projects [Figure 37].

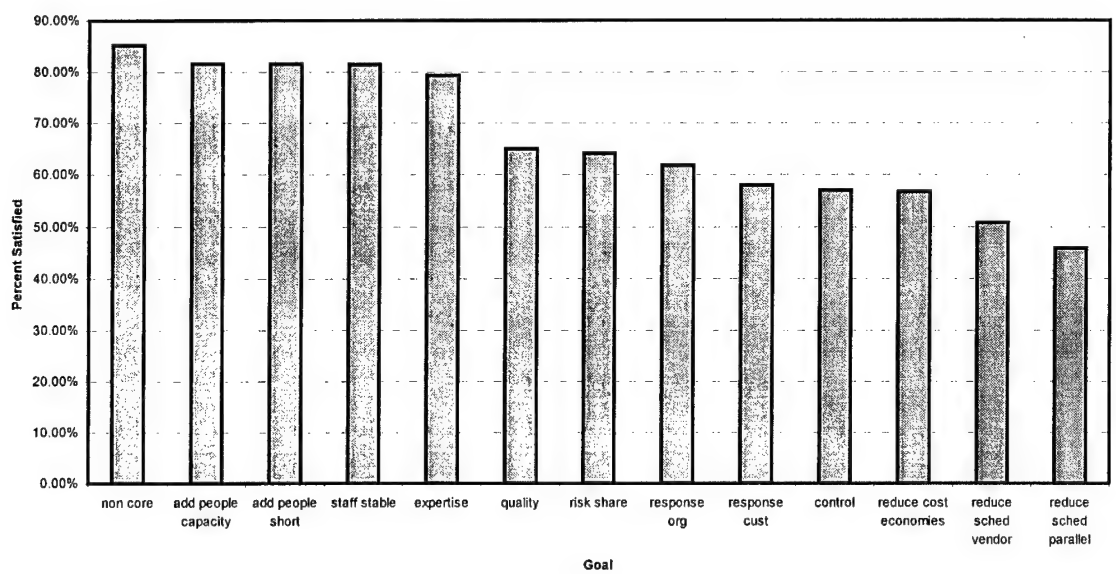


Figure 36: Outsourcing Goal Satisfaction

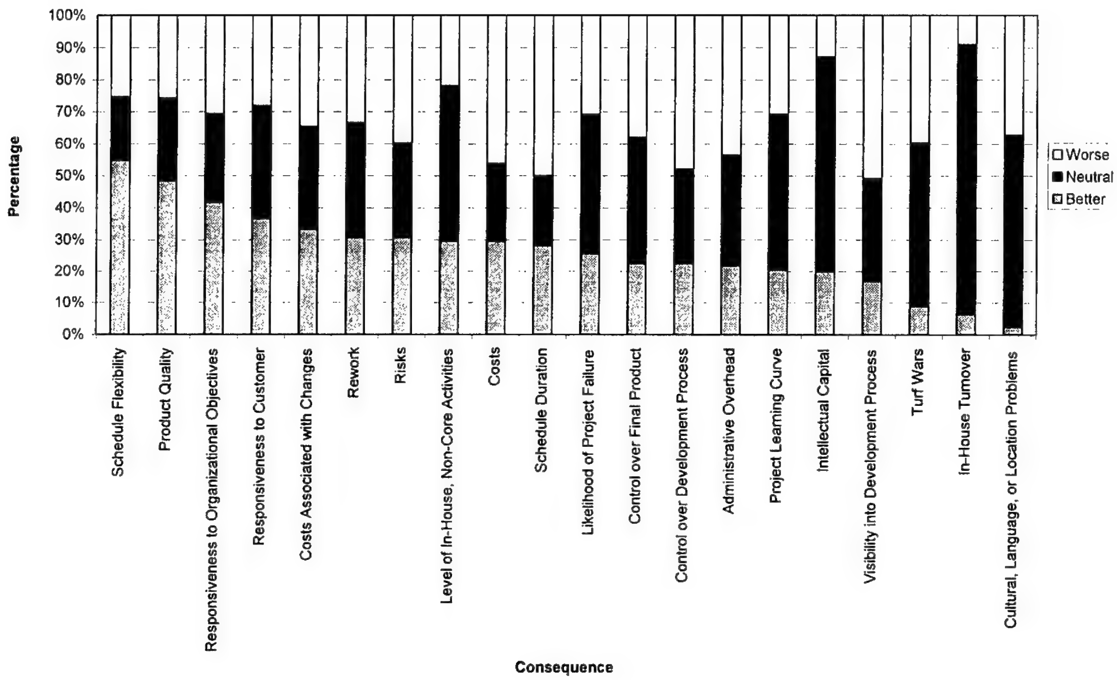


Figure 37: Outsourcing Consequences

4.9 Consequences

The outcomes of outsourcing projects were analyzed using regression and neural network techniques to produce prediction rules for a decision support tool. Potential inputs to each regression model included the processes outsourced, software domains, and products outsourced. Each outcome was subjected to a step-wise linear regression to ensure only significant factors were selected for each rule. The resulting amounts of variance explained, R Square, are lower than originally expected because of the choice of using stepwise regression rather than simply entering each possible factor into the regression model. The latter choice would, however, produce models explaining a high percentage of the dependent variable's variance, but with potentially flawed input from statistically insignificant factors. A 95 percent confidence level was chosen to accept a

variable into the model at each step with a corresponding 90 confidence required to subsequently remove factors. The notation follows the same format as described in Section 4.8.4.

4.9.1.1 Administrative Overhead

Respondents indicated a slightly higher level of administrative overhead associated with outsourcing in general. While outsourcing documentation efforts correlated with reduced levels of administrative overhead, projects in the enterprise manufacturing and shrink-wrap utilities sub domains showed significant association with increased administrative overhead (Figure 38).

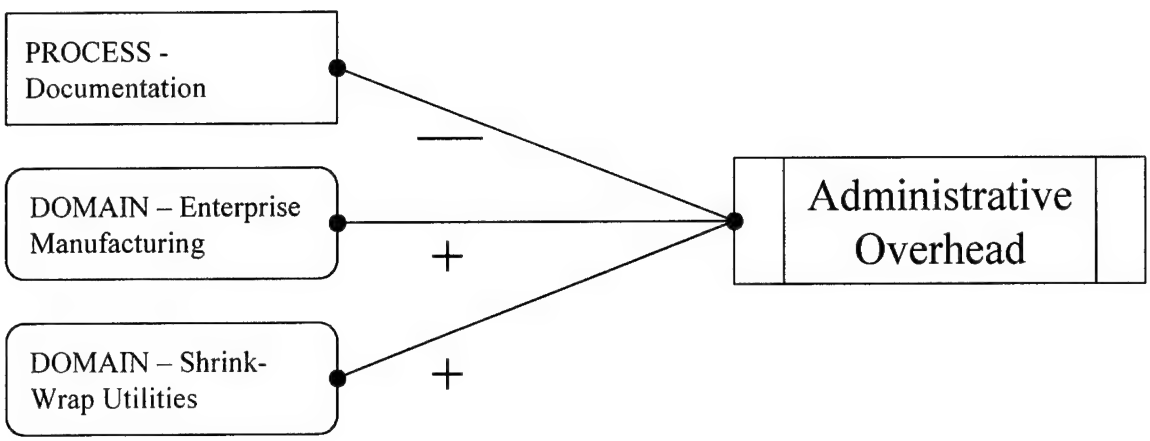


Figure 38: Factors associated with Administrative Overhead

4.9.1.2 Control over Final Product

Intuitively, one expects that offloading software development work to outsource developers would reduce a manager's control over the final software product, but Thomsett contends that some organizations turn to outsourcing because in house developers have established their own agenda and subsequently failed to meet user needs

and requirements (Thomsett "Outsourcing: The Great Debate"). Survey respondents reported a slightly lower, albeit not significantly lower, average level of control over the final product. Outsourcing customized versions of common applications correlates with further reduced control over the final product. In contrast, outsourcing software maintenance corresponds to increased control over the final product (Figure 39).

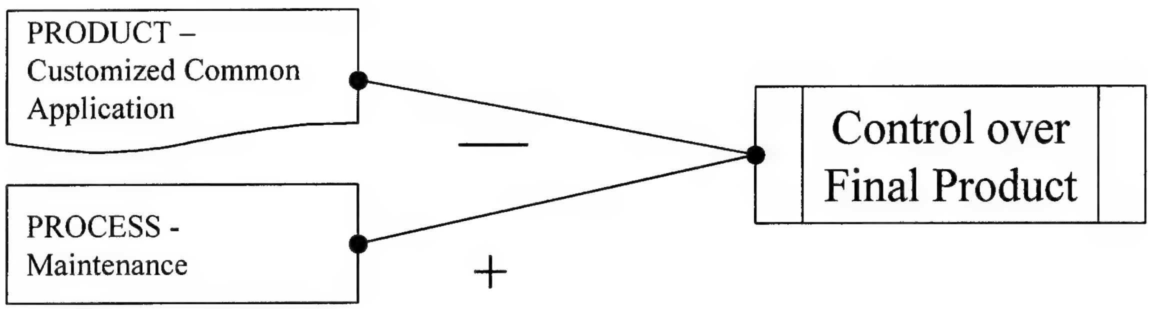


Figure 39: Factors associated with Control over the Final Product

4.9.1.3 Control over Outsourced Project Management Process

Respondents also indicated that control over the project management process is slightly higher for outsourcing projects. Outsourcing the design process correlated with drastically reduced control while respondents indicated that projects outsourcing reengineering correlated strongly with improved control of the project management process. Analysis also suggests that outsourcing in the software component development domain and customized versions of common applications was associated with a significant reduction in process control (Figure 40).

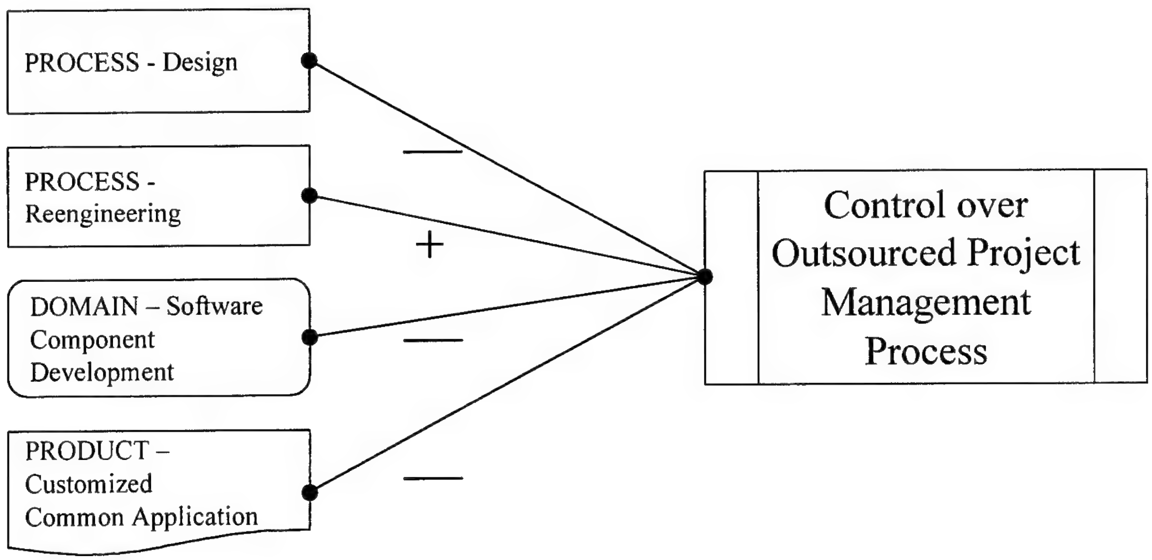


Figure 40: Factors Affecting Control over Outsourced Project Management

4.9.1.4 Costs Associated with Changes

Respondents reported significantly increased levels of costs associated with changes during the outsourcing project compared to similar costs for changes on an in-house development. The problem of excessive costs from design and requirement changes also plagues engineering contract development. Projects in the operating systems sub domain of software component development correlated with additional increases in change costs (Figure 41).

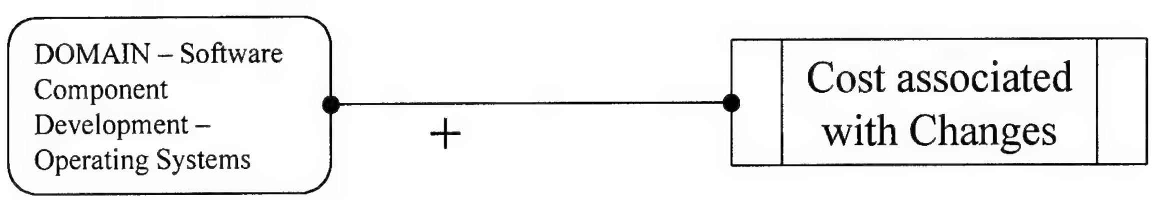


Figure 41: Factor related to Costs associated with Changes

4.9.1.5 Cultural, Location, and Language Problems

The likelihood of cultural, location-related, or language-based problems were significantly higher for outsourced software developments than for in-house efforts. Clearly the main factor here was outsourcing to organizations in different countries with different languages. In this analysis, outsourcing shrink-wrap utilities and avionics software projects also corresponded to additional increases while outsourcing software component development related to lower levels of these problems. Presumably, projects in the shrink-wrap utilities and avionics sub domains were more likely to be offshore efforts than projects in other domains (Figure 42).

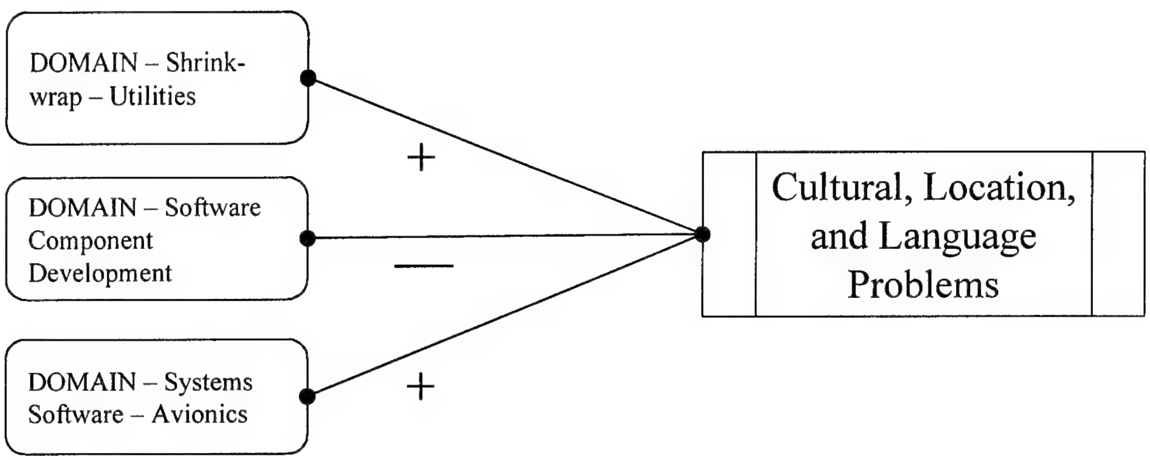


Figure 42: Factors relating to Cultural, Location, and Language Problems

4.9.1.6 Development Risks

While several authors suggested outsourcing as a means of risk sharing, survey respondents indicated this was not a statistically significant goal for their outsourcing arrangements. Projects in the enterprise software domain, systems software domain, and

those outsourcing configuration management tasks all correlate with improved (reduced) outsourcing development risk levels (Figure 43).

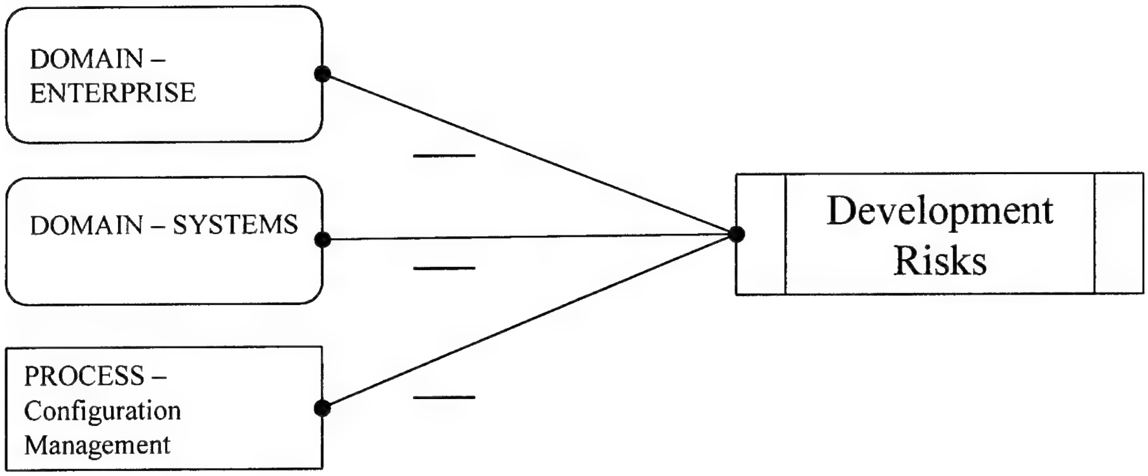


Figure 43: Factors Related to Development Risks

4.9.1.7 Development Schedule

Respondents clearly showed that reduction of development schedule was an important goal for software outsourcing. Unfortunately, none of the observed independent variables correlated with significant changes in development schedule. Overall, respondents indicated no significant difference in project duration between in-house and similar outsourced projects.

4.9.1.8 In-House Effort Spent on Non-Core Activities

Respondents indicated outsourcing projects have significantly less in-house administrative overhead than traditional in-house projects. Two factors appear to mitigate this improvement (Figure 44). First, software projects in the interactive web-site development sub domain correlate to increased in-house overhead. Second, outsourcing

COTS products correlated with increased overhead. These results were consistent with an intuitive understanding of the extra effort required to integrate COTS products into a comprehensive system and the need to clearly communicate in-house information for interactive web-site development. Overall, the idea that outsourcing projects had less administrative overhead than similar in-house projects was one of the attractive features of outsourcing.

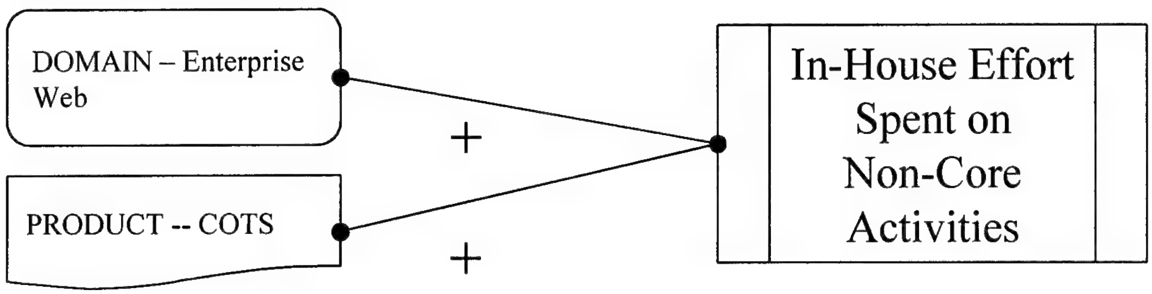


Figure 44: Factors Affecting Non-Core Activities

4.9.1.9 In-House Personnel Turnover

Respondents indicated no significant change in personnel turnover levels between in-house and outsourced software development projects. Outsourcing development of CASE tools corresponded to decreased in-house turnover levels while outsourcing the software engineering support process slightly increased in-house personnel turnover levels (Figure 45).

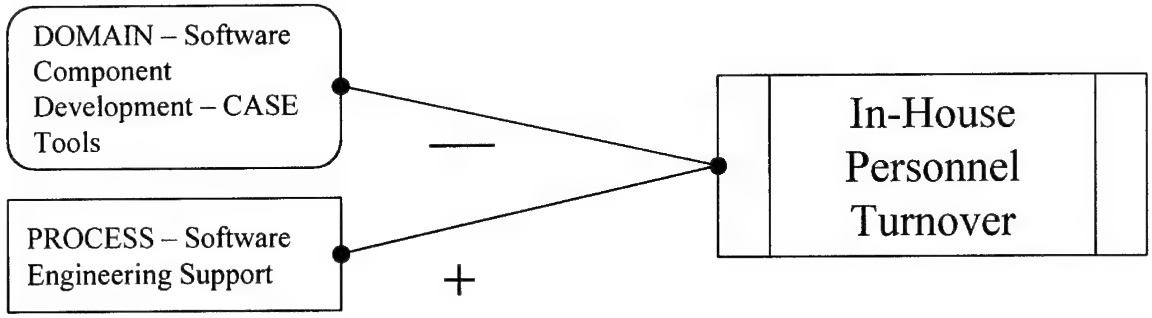


Figure 45: Factors associated with In-House Personnel Turnover

4.9.1.10 Intellectual Capital

Respondents indicated no significant change in their organizations' rights to software products developed via outsourcing compared to in-house developed products. The analysis showed that outsourcing the fielding process corresponds to reduced intellectual capital rights while outsourcing the training process correlates with increased rights. In general, a combination of both product and process outsourcing was surprisingly found to be significantly related to reduced intellectual capital rights. The researcher expected to see a negative correlation between product outsourcing and intellectual capital. Several software domains and sub domains demonstrated correlation with significant positive and negative impacts of intellectual property rights (Figure 46). Mainly intellectual capital is a consequence of the contract vehicle agreed to by the vendor and purchasing organization.

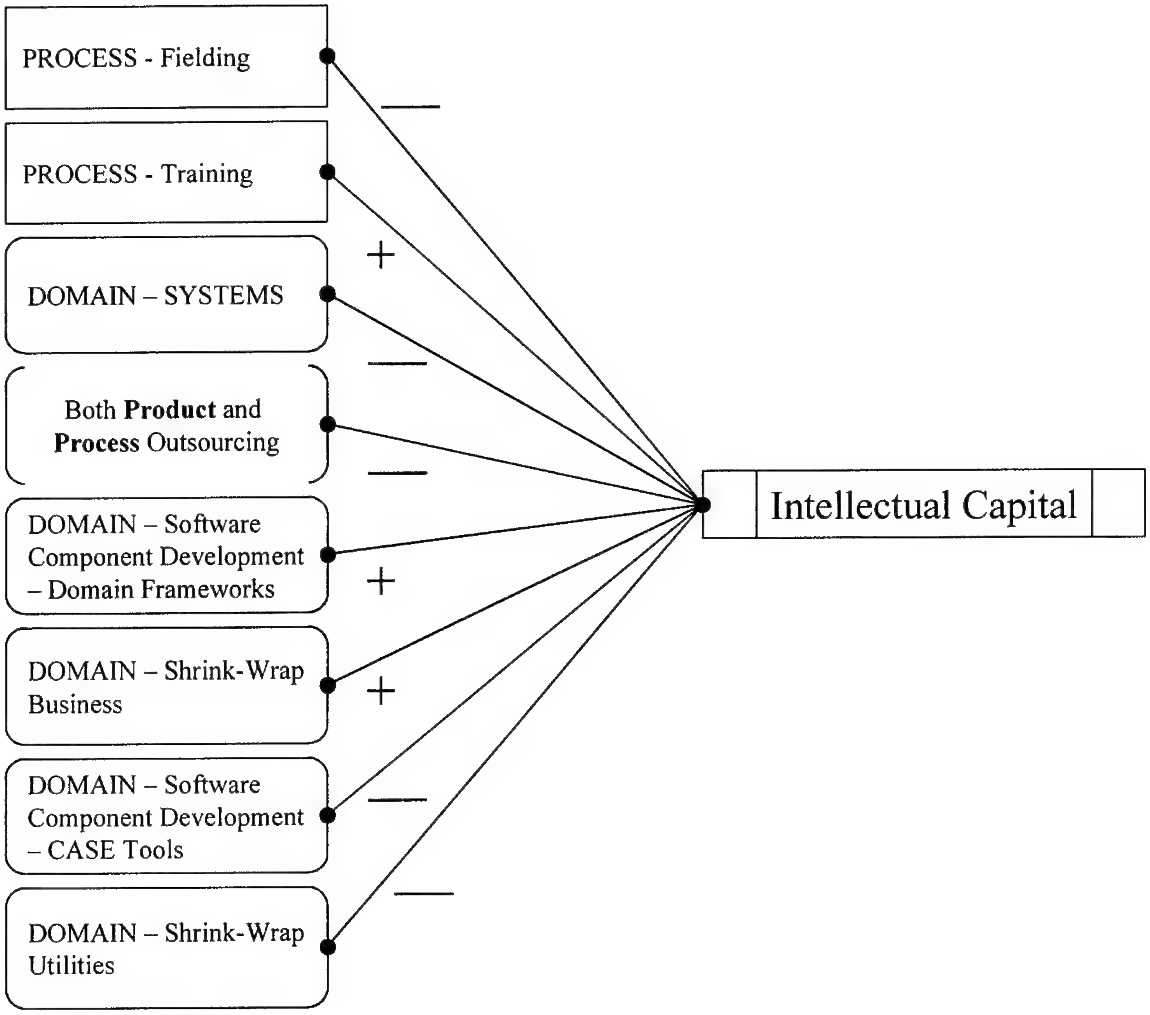


Figure 46: Factors associated with Intellectual Capital Rights

4.9.1.11 Likelihood of a Failed or Cancelled Project

Demarco and Lister contend that nearly thirty percent of outsourced software projects result in dissatisfaction or failure (Demarco and Lister). Respondents to this survey indicated no significant difference between failure levels of outsourced projects and in-house efforts. Outsourcing tool support did, however, correspond to an increased failure possibility. In contrast, outsourcing configuration management and software engineering support processes correlated to a significantly reduced likelihood of project

failure (Figure 47). One possible explanation is that organizations outsourcing support processes are more likely to have higher process maturity levels and thus better understand the need for thorough process definitions.

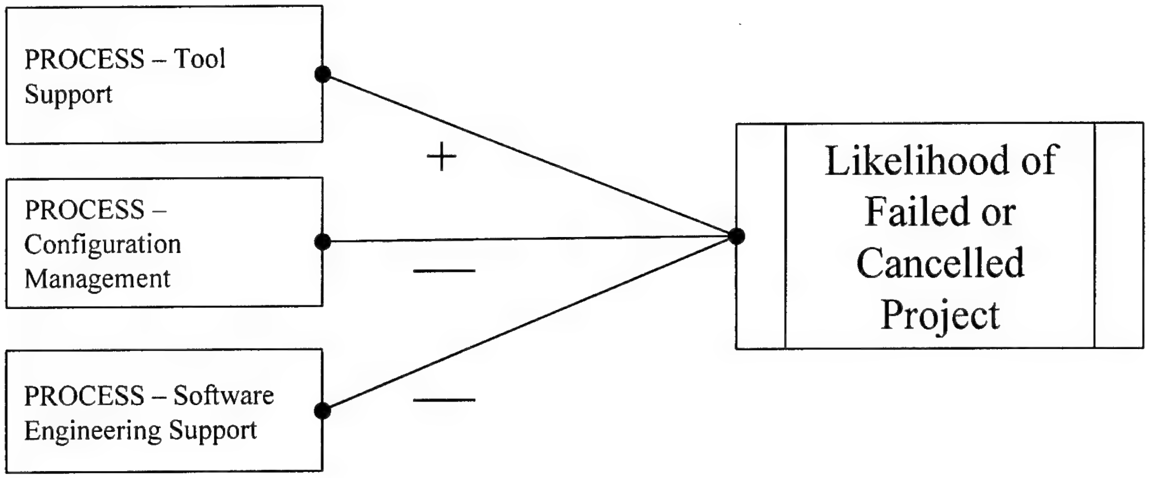


Figure 47: Factors associated with the Likelihood of a Failed or Cancelled Project

4.9.1.12 Product Quality

A regression model was used to help predict product quality on the seven-point Likert scale. The results are shown in Appendix A. In this case, product quality begins slightly above 'No Change' on the response scale. Outsourcing COTS products correlates to a significant reduction in product quality while outsourcing reengineering efforts suggests product quality improvement (Figure 48).

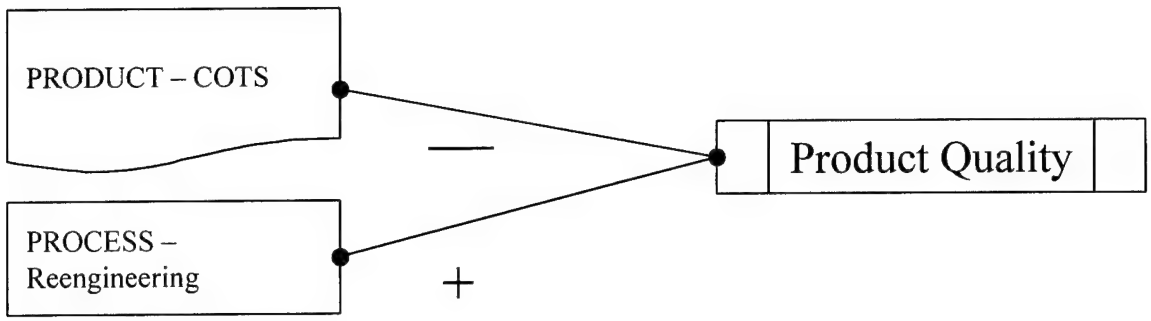


Figure 48: Factors Affecting Product Quality

4.9.1.13 Project Cost

Respondents placed cost reduction as the fourth least important of the 14 outsourcing goals. Outsourcing CASE tool products in the software component domain correlates with a reduction in total project cost while custom products and projects in the enterprise manufacturing domain correlate with increased project costs (Figure 49).

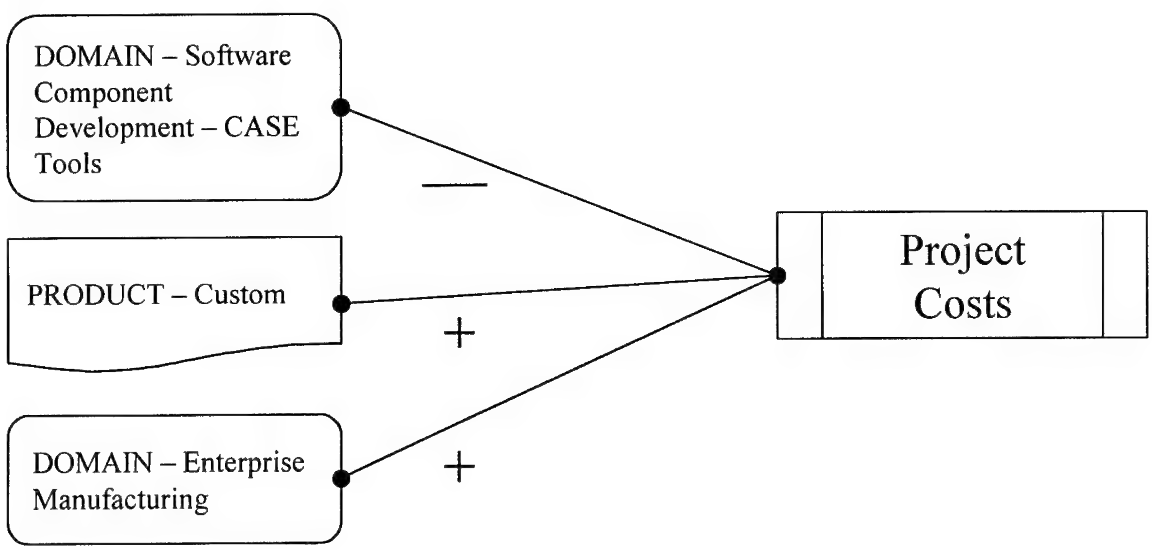


Figure 49: Factors associated with Project Cost

4.9.1.14 Project Learning Curve

Brooks argued that adding personnel to a late software project makes it even later (Brooks). Outsourcing software development efforts are similar to adding new project personnel with concerns over domain knowledge, experience, and effort required to attain acceptable productivity levels. For this survey's purposes, a long (high) learning curve implies slower time-to-productivity. Thus a reduction in learning curve is considered an improvement and means that project personnel gain project knowledge more quickly. According to survey respondents, the outsourced project learning curve is not significantly different than in-house learning curves. Only outsourcing order entry systems correlated to a change (reduction) in the outsourced learning curve (Figure 50). This implies faster learning on these projects and makes sense because of the high level of definition of order entry systems compared to other less established software domains.

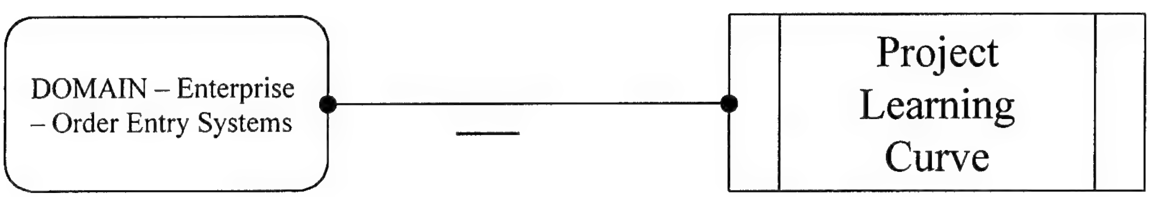


Figure 50: Factor associated with Project Learning Curve

4.9.1.15 Responsiveness to Customer Objectives

Respondents indicated improved responsiveness to customer objectives is an important aspect of software outsourcing. Outsourcing software engineering support correlates with reduced responsiveness to customer objectives (Figure 51).

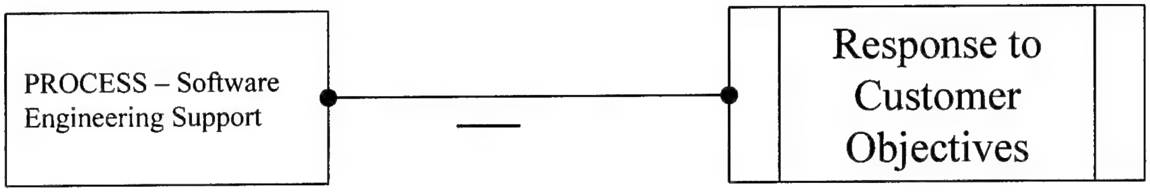


Figure 51: Factors Related to Responsiveness to Customer Objectives

4.9.1.16 Responsiveness to Organizational Objectives

Similar to control over the development process, improving responsiveness to organizational objectives was shown to be an outsourcing motivation (Section 4.8). Figure 52 shows that only outsourcing software engineering support correlates with a change (reduction) in responsiveness to organizational objectives.

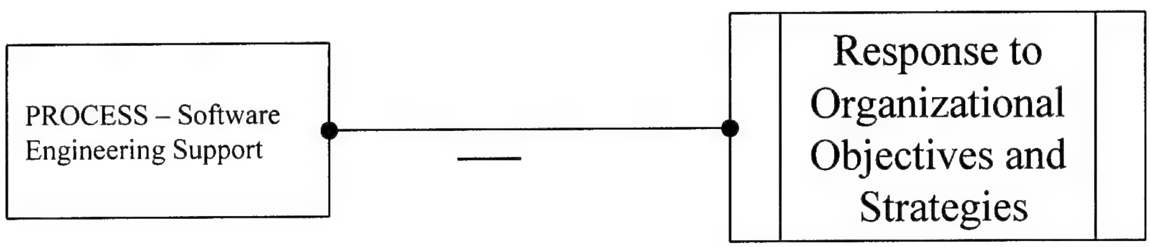


Figure 52: Factors Affecting Responsiveness to Organizational Objectives

4.9.1.17 Rework

As shown in Table 13, survey respondents identified no significant difference between the level of rework required for in-house and outsourced projects. Regression analysis did, however, show that COTS products and projects in the software component development domain correspond to increased rework levels (Figure 53).

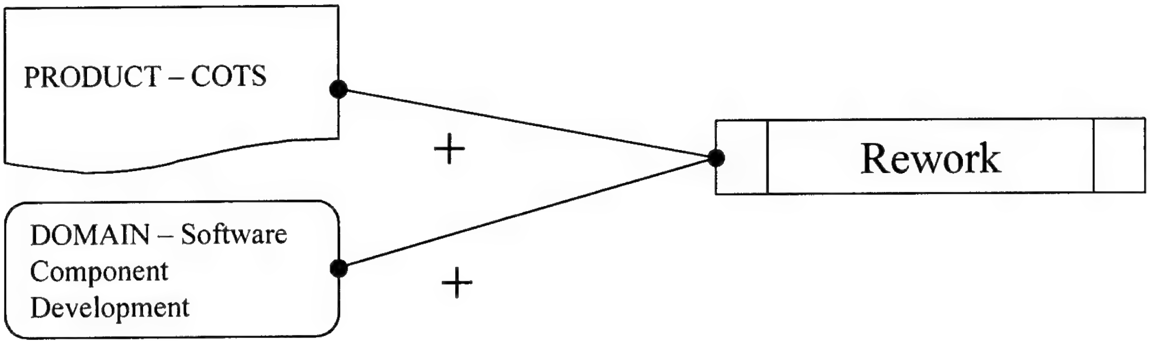


Figure 53: Factors associated with Rework

4.9.1.18 Schedule Flexibility

Again, respondents identified no significant difference between an in-house project's schedule flexibility and that of outsourced software development projects. Outsourcing projects in the accounting sub domain of enterprise systems correlated with significantly higher project schedule flexibility (Figure 54).

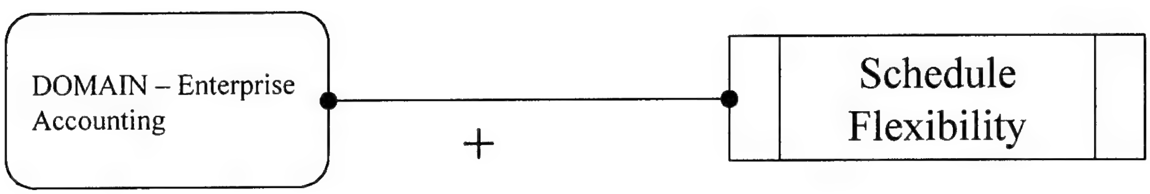


Figure 54: Factor associated with Schedule Flexibility

4.9.1.19 Cross-Functional Conflicts

Respondents strongly supported an initial contention that increasing the number of organizational lines of communication and boundaries associated with outsourcing resulted in a significantly higher likelihood of cross-functional conflicts (originally termed "turf wars" in the survey) within the development project. These conflicts arise from misunderstandings of project requirements, a lack of clearly defined organizational project responsibilities, and unwillingness to accept fault for mistakes (or desire to shift

blame). While outsourcing software engineering support and tool support process correlated with further conflicts, projects outsourcing application support corresponded to significantly decreased likelihood of these problems (Figure 55). Finally, outsourcing COTS products and projects in the enterprise manufacturing and device driver sub domains indicate increased likelihood of cross-functional conflicts.

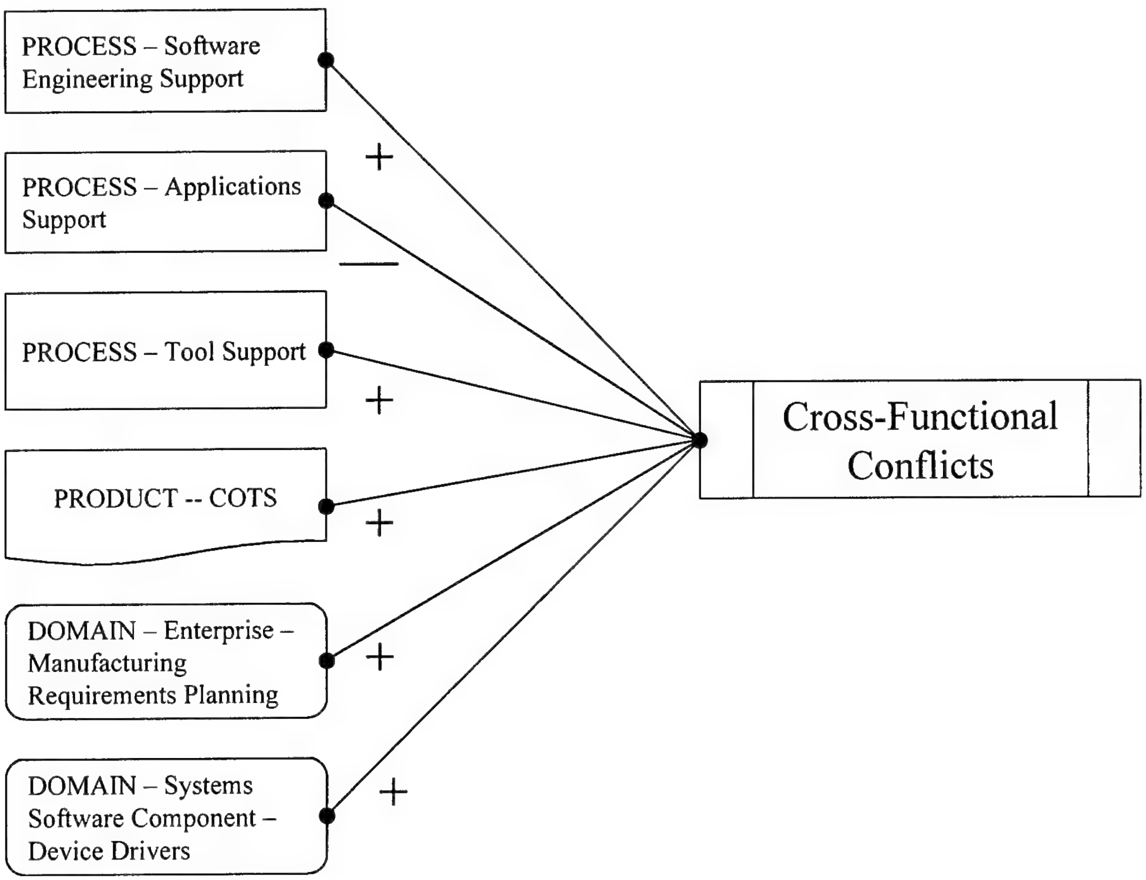


Figure 55: Factors associated with Cross-Functional Conflicts

4.9.1.20 Visibility into the Software Development Project

Visibility into the software development process is, on average, significantly reduced for outsourcing projects than for in-house software development efforts. Respondents indicated that outsourcing reengineering efforts, not outsourcing products,

and outsourcing custom products corresponded with increased visibility into the development process (Figure 56).

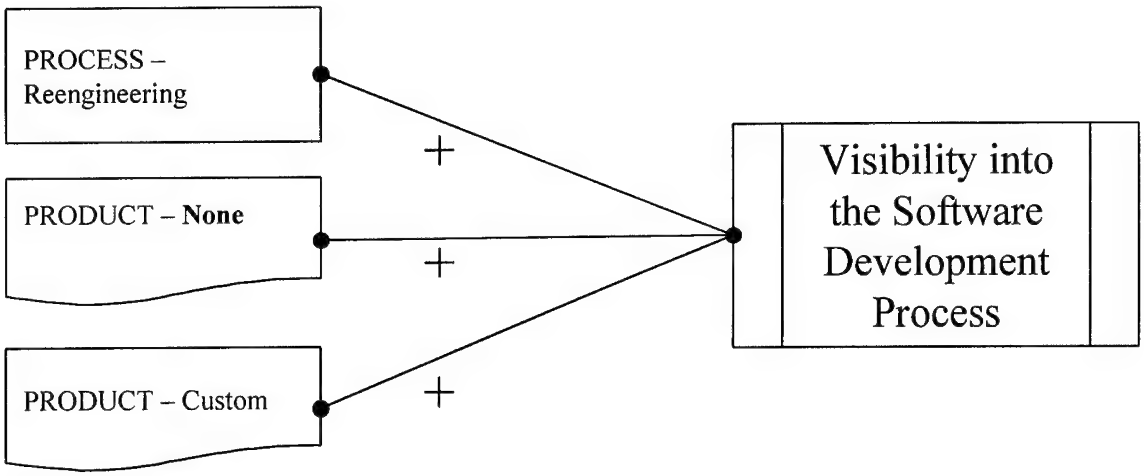


Figure 56: Factors associated with Visibility into the Software Development Project

4.10 Assertions

Section IV of the survey asked each respondent to indicate a level of agreement with specific assertions about software development outsourcing. The first grouping, relationship assertions, indicates a high level of agreement assertions concerning:

- frequent reviews
- communication influence
- previous working experience
- visibility into vendor processes, and
- working with a vendor that has an established track record [Figure 57].

Only distance between customer and vendor showed an overall negative influence on project success. The negative correlation between project success and distance between customer and vendor organizations indicates the "follow-the-sun" and 24-hour

development cycles advertised by offshore developers are less appealing than their reduced labor costs.

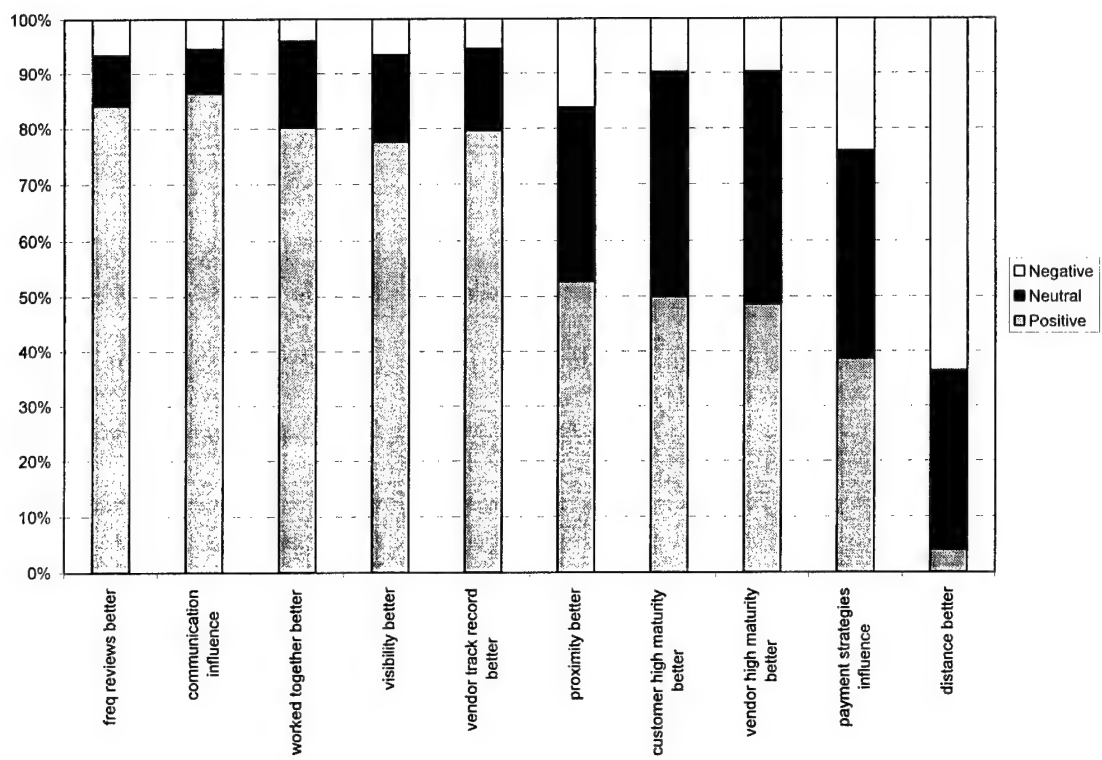


Figure 57: Results of Relationship Assertions

The second grouping, project assertions, also yielded positive results. Specific domains apparently lend themselves to outsourcing, vendor tool and domain experience, vendor reuse of existing products, and customer domain experience clearly improved the likelihood of outsourcing project success [Figure 58]. The availability of many vendors, larger products, and larger efforts were indicated as items that did not improve an outsourcing project's chances for success.

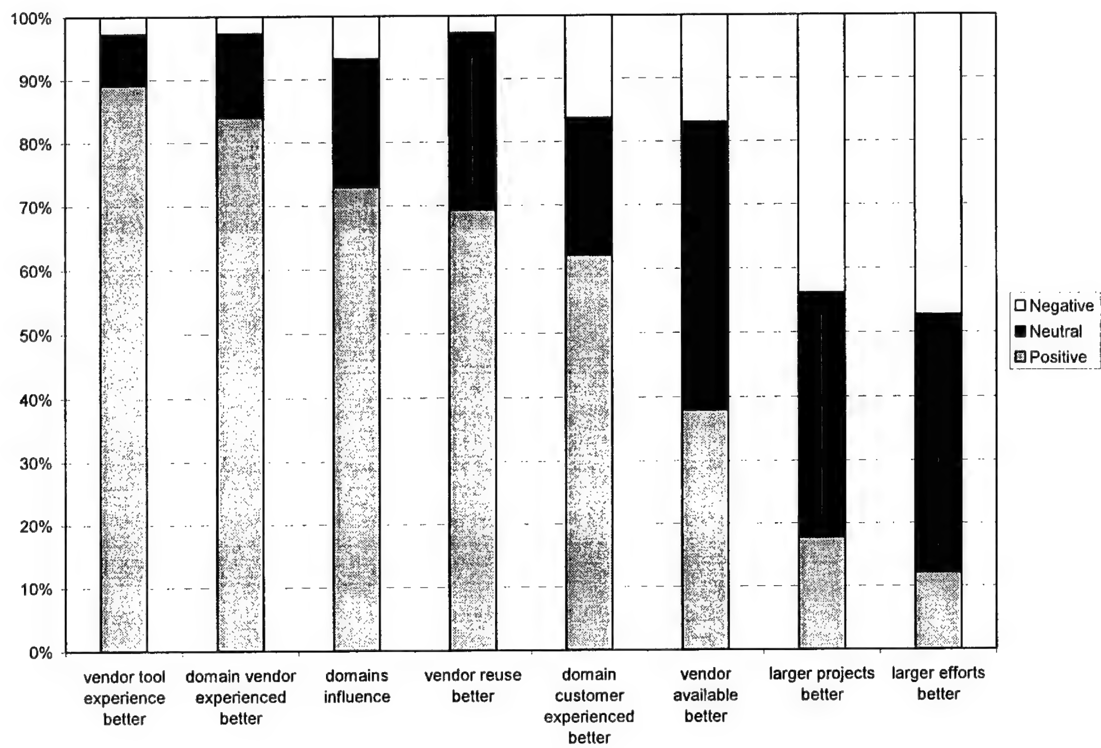


Figure 58: Results of Project Assertions

The goal/expectation assertions showed that aggressive cost and schedule reduction goals detracted from project success [Figure 59]. The implication is that modest cost and schedule reduction expectations are more realistic for outsourcing projects.

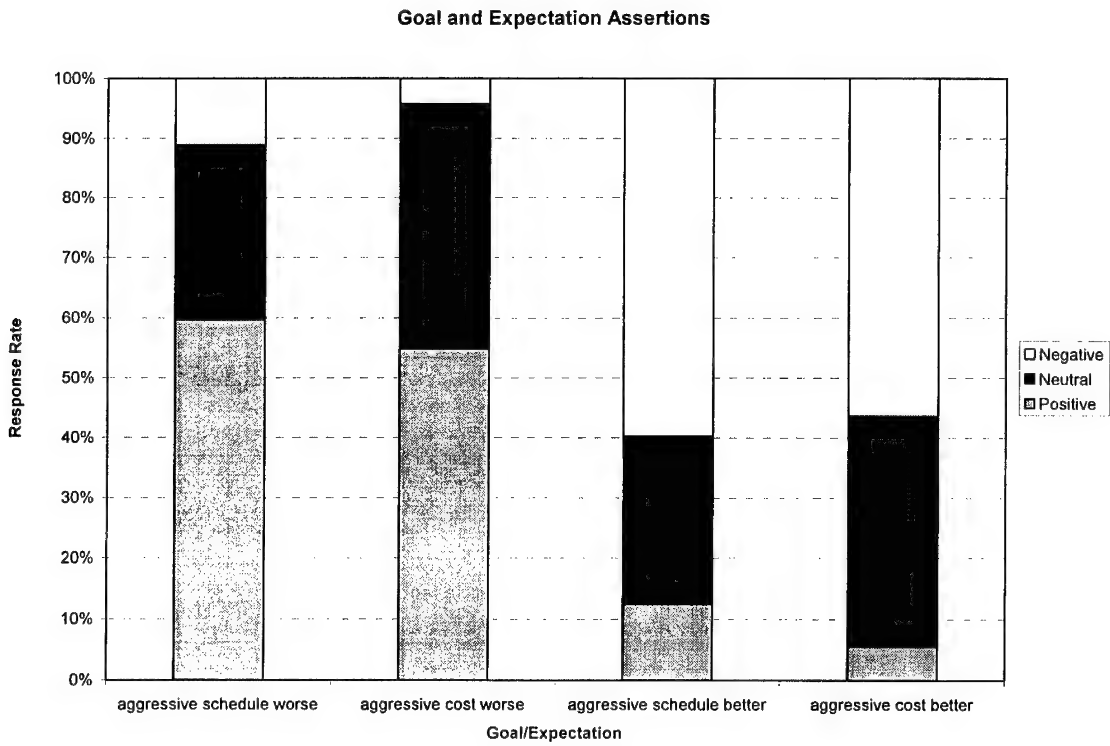


Figure 59: Results of Goal and Expectation Assertions

Figure 60 shows that respondents agreed that modular products are better suited for outsourcing projects and that lower complexity products also increased the likelihood of successful outsourcing development projects.

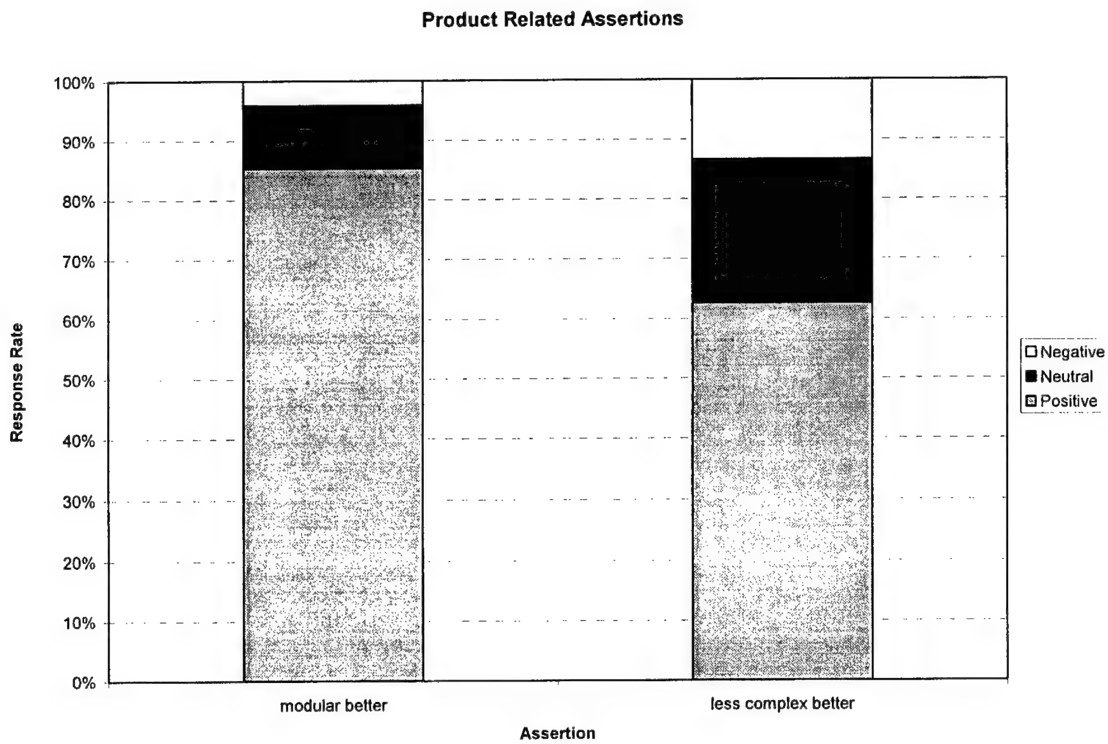


Figure 60: Results of Product Assertions

Defining organizational responsibilities and interfaces and having common methods and tools, which allow for seamless information flow between customer and vendor, improved chances for outsourcing success [Figure 61]. The remaining process assertions had moderate responses indicating project improvement and less than ten percent of responses indicating reduced project success.

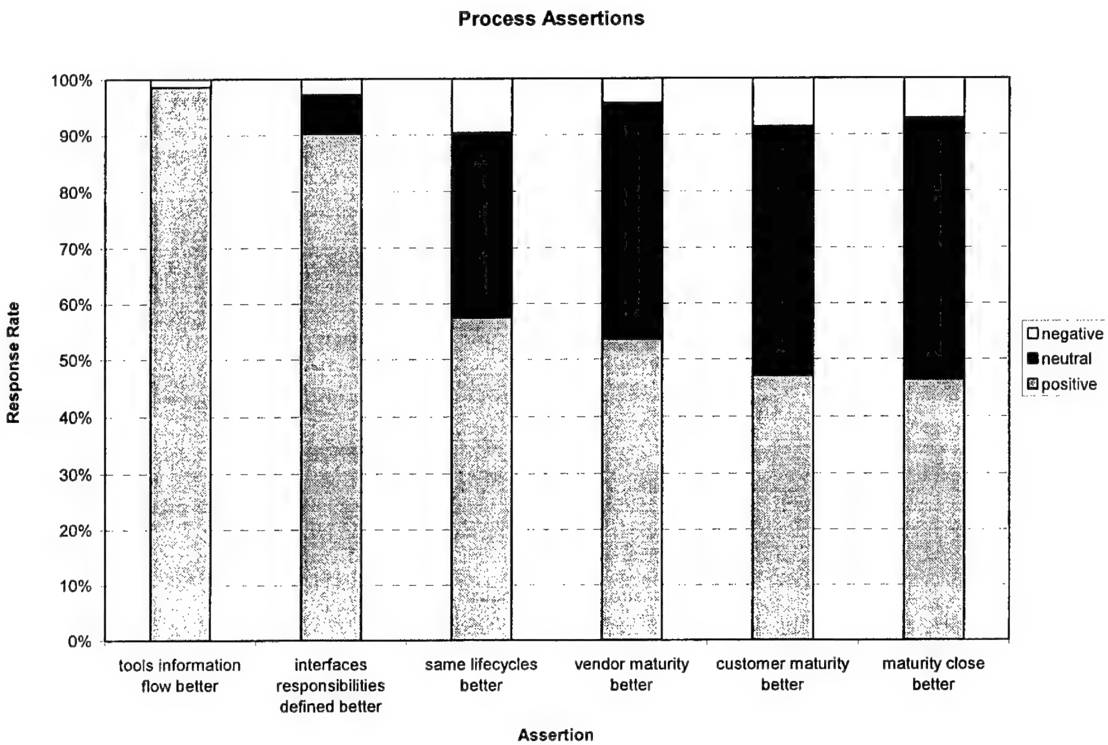


Figure 61: Process Assertions

The product assertions were even clearer, showing all but component size had a significant impact on project success [Figure 62].

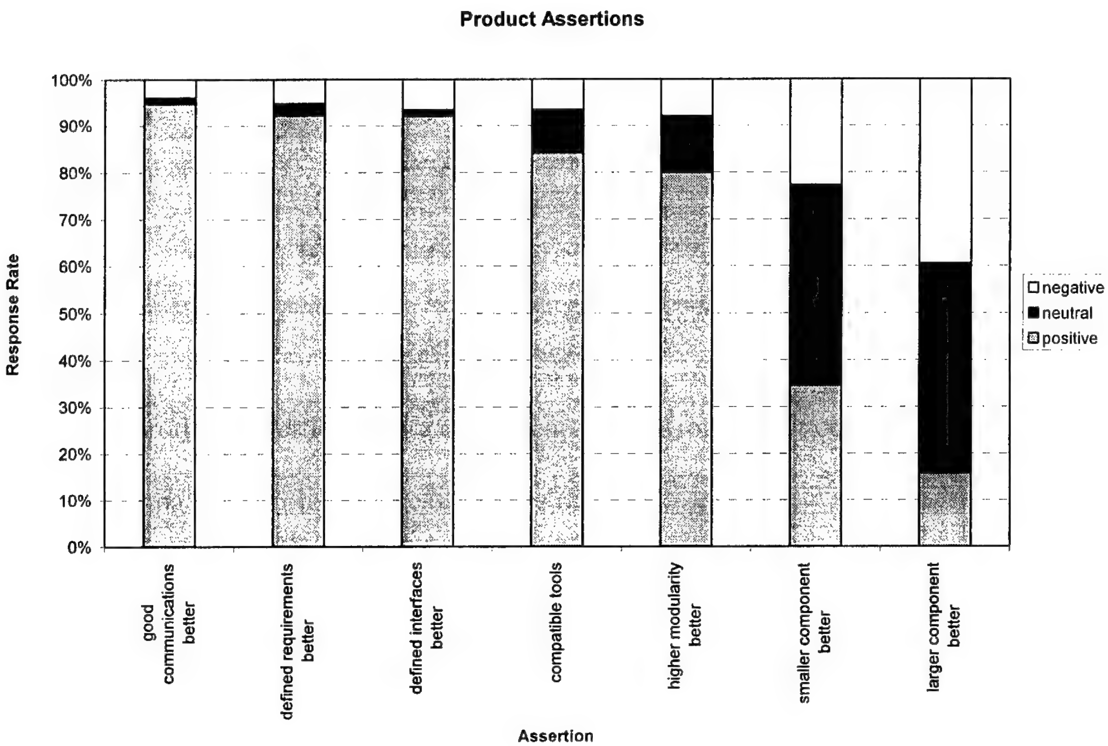


Figure 62: Product Assertions

4.11 Results Summary

Data from the survey responses were analyzed statistically to produce a new understanding of outsourcing demographics, decision-maker roles, motivations, outsourcing strategies, and most importantly rules-of-thumb which can be used to predict the outcome of software development outsourcing projects. Finally, general assertions about outsourcing relationships, products, and projects were captured to help suggest improvement options for decision support tool users.

The data presented in this chapter yielded rules (presented in Section 4.9) and assertions (discussed in Section 4.10) that will help outsourcing decision makers (Section 4.4) select appropriate outsourcing strategies for their specific project needs. The rules and assertions were next encoded in a decision support tool to allow decision makers to perform trade-off analyses among different strategies and relationship management approaches. Details about the decision support tool implementation and use cases are presented in Chapter 5.

5. *Decision Support Tool*

A simple way to understand the taxonomy is by using a rule-based decision support system. Based upon survey work, project situations and strategies were correlated with success or failure to meet individual or combined groups of goals. The resulting rules were used to produce a decision support system that will enable users to select successful outsourcing strategies for their project scenario and goals. Where possible, these rules should be understandable and explainable for each potential outcome. Collection of this foundational data will result in a more complete understanding of the causal factors for success in outsourcing software developments.

This chapter begins with a presentation of tool inputs, outputs, and sample use cases. The remainder of this chapter (Sections 5.4 through 5.6) covers the specific types of rules included in the system, implementation decisions made, and presents a brief tool user's guide.

5.1 Inputs

While each project is unique, they can be grouped according to common characteristics. Current literature has limited information about outsourcing success and failure for case study projects. The authors use case studies to improve outsourcing relationship management without considering the possible impact of project domain and product types. The outsourcing rules fill these gaps and classify success according to outsourcing goals and motivations. The survey defined project scenario variables and the collected actual values that serve as inputs to the decision support tool.

5.1.1 Project Domain

Project domain refers to the type of software development effort. Examples include engineering support, embedded software, shrink-wrap desktop applications, management information systems, military software, communications applications, and networking software. Several authors have suggested some of these domains are more appropriate than others for outsourcing. Dedene and DeVreese indicate reengineering efforts are especially conducive to successful outsourcing due to their well-defined nature (Dedene and DeVreese). According to Wantanabe, the Japanese corporation OMRON had success outsourcing projects such as tools and utilities for operating systems, business and manufacturing applications, and applications using state-of-the-art technologies (Watanabe). In contrast, OMRON had difficulty with outsourcing applications that required domain knowledge (e.g., ATM machines and public transportation ticket vending machines). Figure 63 shows the user input screen for software domain entry. The domains and sub domains in Figure 63 are a compilation of the statistically significant domain factors found in all of the regression rules.

	B	C
3	**DOMAIN**	
4	**Enterprise Software Outsourcing**	**FALSE**
5	Enterprise - Accounting	FALSE
6	Enterprise - Manufacturing Requirements Planning	FALSE
7	Enterprise - Payrol Systems	FALSE
8	Enterprise - Order Entry Systems	FALSE
9	Enterprise - Scripting	FALSE
10	Enterprise - Web	FALSE
11	Enterprise - OTHER	FALSE
12		
13	**Shrinkwrap Software Outsourcing**	**FALSE**
14	Sh rinkwrap - Entertainment	FALSE
15	Shrinkwrap - Business	FALSE
16	Shrinkwrap - Utilities	FALSE
17	Shrinkwrap - Internet	FALSE
18	Shrinkwrap - OTHER	FALSE
19		
20	**Software Component Outsourcing**	**FALSE**
21	Software Component Development - Domain Frameworks	FALSE
22	Software Component Development - CASE Tools	FALSE
23	Software Component Development - Class Libraries	FALSE
24	Software Component Development - Operating Systems	FALSE
25	Software Component Development - Development Tools	FALSE
26	Software Component Development - OTHER	FALSE
27		
28	**Systems Software Outsourcing**	**TRUE**
29	Systems - Avionics	TRUE
30	Systems - Embedded Controllers and Firm-ware	FALSE
31	Systems - Communications Systems	FALSE
32	Systems - Device Drivers	FALSE
33	Systems - OTHER	FALSE

Figure 63: Software Domains Tool Inputs

5.1.2 Development Processes Outsourced

The next step for users is to enter which processes they plan to outsource. Figure 64 shows the user selection screen for inputting which processes will be outsourced. This input forms another part of the antecedent values that are activated by the inference engine.

	B	C
35	**PROCESS Outsourcing**	**TRUE**
36	Requirements	FALSE
37	Design	FALSE
38	Testing	TRUE
39	Maintenance	FALSE
40	Reengineering	FALSE
41	Applications Support	FALSE
42	Training	FALSE
43	Specification	FALSE
44	Documentation	FALSE
45	Coding	TRUE
46	Fielding	TRUE
47	Configuration Management	FALSE
48	Tool Support	FALSE
49	Software Engineering Support	FALSE
50	OTHER	TRUE

Figure 64: Outsourced Processes Input Screen

5.1.3 Types of Product Components Outsourced

As previously mentioned, it is impossible to delineate all of the possible product components that may be outsourced. Instead, Figure 65 shows the types of product components that might be outsourced. Users enter their particular product component type as the final main input to the rule-base.

	B	C
52	**PRODUCT Outsourcing**	**TRUE**
53	COTS	TRUE
54	Custom	FALSE
55	Customized Common Application	TRUE

Figure 65: Input Form for Outsourced Product Component Types

5.1.4 Goals

While specific project goals are not entered, after activating the outsourcing rule-base, users can select those consequences requiring further improvement. This input, shown in the right column of Figure 66, determines which assertion rules are activated to produce suggestion for improving the predicted outsourcing consequences. In Figure 66,

hypothetical output values shown in Column G represent points on same seven-point response scale used the survey and shown in Figure 67. Column H of Figure 66 shows that the tool user has expressed an interest in further improving the consequence, "control over project management process."

	E	F	G	H
3	**CONSEQUENCES**	**Input Values**	**Output Values**	**Would you like suggestions?**
4	control over final product	4	2.642	No
5	control over project management process	4	4.04	Yes
6	intellectual capital	4	2.451	No
7	product quality	4	3.144	No
8	responsiveness to customer objectives	4	4.407	No
9	responsiveness to organizational objectives and strategies	4	4.473	No
10	schedule flexibility	4	4.107	No
11	visibility into the software development process	4	2.623	No
12	administrative overhead	4	4.563	No
13	costs associated with changes	4	4.446	No
14	cultural, location, and language problems	4	5.193	No
15	development risks	4	3.332	No
16	development schedule	4	4	No
17	in-house effort spent on non-core activities	4	4.46	No
18	in-house personnel turnover	4	3.997	No
19	likelihood of a failed or cancelled project	4	3.957	No
20	project costs	4	3.652	No
21	project learning curve	4	4.221	No
22	rework	4	5.011	No
23	turf wars	4	5.033	No

Figure 66: Goal Input Screen

Decreased Dramatically	Decreased Significantly	Decreased Slightly	No Change	Increased Slightly	Increased Significantly	Increased Dramatically
1	2	3	4	5	6	7

Figure 67: Seven-Point Response Scale

5.2 Outputs

5.2.1 Predicted Consequences

For the project inputs and outsourcing strategy, heuristic rules identify how the consequences of a scenario will differ from a project performed completely in-house. For example, if a goal is to significantly reduce total project costs, similar historical

experience will be used to suggest whether meeting that goal is likely. Assertions can then be activated to identify suggestions to improve each consequence.

5.2.2 Summary of Inputs

In addition to indicating the likelihood of goal achievement, the tool will summarize the user inputs (project variables and outsourcing strategy) to help identify the specific scenario and 'what-if' comparisons.

5.2.3 Suggestion of Possible Strategy Modifications

If the given project variables and strategy do not meet the prioritized goals, the tool can use its assertions to suggest strategy changes which might improve the likelihood of meeting these goals. The assertions account for several factors that were not collected numerically during the industry survey. Respondents indicated strong agreement between these factors and several consequences as discussed in Section 4.10.

5.2.3.1 Organizational Domain Expertise

To make an informed outsourcing decision, a manager or consultant must know the customer organization's capabilities within the chosen application type. For example, the world's foremost avionics software developer would have little incentive to outsource work they lead the world in, but may choose to have an outside vendor produce their time and expense tracking software.

5.2.3.2 Availability of Vendors with Domain Expertise

, outsourcing a project is not possible if no software developers with the desired domain experience are available. This factor also considers whether the potential vendors have more domain expertise than in-house developers.

Another aspect of domain expertise could be considered programming language or development tool familiarity. The proposed decision support system allows customers to decide for example, whether to outsource the maintenance of a legacy software system written in an outmoded second-generation programming language.

5.2.3.3 Project Size

The overhead required to manage an outsourcing relationship must somehow be offset with cost, schedule, staffing, quality, or other benefits to the customer organization. Apparently, outsourced projects must be a certain minimum effort size to produce these benefits. According to Shrinkant Inamdar, the second-in-command at Motorola's SEI level-5 Bangalore facility,

> "No offshore outsourcing venture of less than a particular size will ever be successful, for various reasons. Some of the important reasons are scalable commitment, perception of lack of growth opportunities, and hence, lack of motivation, inadequate availability of buffer resources for risk management, inadequate number of people for domain expertise development strategies, and lack of commitment because of a lack of investment. While one can start with a smaller size, all plans should preferably be aimed at increasing the size beyond this critical mass as quickly as possible. My qualitative analysis makes me believe that this critical size is at least 25 developers, and can be as high as 100 depending on the environment." (Yourdon, Rubin and Mohnot)

Greg Peek, another outsourcing practitioner, stated, "a minimum size is necessary to demonstrate the costs savings involved" (Yourdon, Rubin and Mohnot). According to

Peek, a project must be at least four person-years of effort to qualify as a solid outsourcing prospect.

5.2.3.4 System Project Modularity

When an organization considers outsourcing a product component, they must understand the complexity and amount of interaction between the subject component and the remainder of the software product.

5.2.3.5 Personnel Constraints

The variable, personnel constraints captures the customer organization's ability to undertake the proposed development effort in-house or to hire additional in-house developers. When neither of these situations is likely, outsourcing becomes a more promising option.

5.2.3.6 Cost Constraints

Nearly every author suggests costs savings as one of the prime outsourcing motivations. Anecdotes of low-cost, offshore development houses have managers turning to outsourcing in increasing numbers (U.S. And Worldwide Outsourcing Markets and Trends 1998-2003). Jarzombek indicates that organizations should only outsource if the projected cost savings is greater than thirty percent. (Jarzombek). Apparently, projections are often overly optimistic, outsourcing relationship management is more effort than expected, and thus end results are typically worse than initial estimates.

5.2.3.7 Schedule Constraints

Like cost constraints, schedule reduction is a key outsourcing motivation. When time is critical and a more experienced, larger vendor staff can produce the project faster than in-house developers, managers will choose to outsource.

5.3 Example Use Cases

During development planning, a software development project manager can use the tool input process to identify the project variables, prioritized project goals, and possible outsourcing strategies. Once the tool is run, the development manager can gauge the strategy's success and review possible modifications. The following hypothetical scenarios will explain how a software development project manager or consultant will use the tool.

5.3.1 Overall Strategy Planning

The United States Air Force has decided to take advantage of new technology and produce the C-18 cargo aircraft. After concept exploration and competitive prototyping, Planes-R-Us is selected as the prime development and production contractor. While the company has developed many previous aircraft, the software project manager is under tremendous schedule pressure. In-house completion projections, based on current in-house staffing levels, extend well beyond deadlines. From past experience, the manager knows that system-level software testing is costly, time consuming, and is not one of Planes-R-Us' organizational strengths. On the surface, it seems like a good idea to outsource the testing effort to an outside vendor. The decision seems like a good way to

augment current personnel, shorten the schedule through concurrency, and improve product quality. To test this hypothesis, the manager enters the project information into the decision support tool along with the project goals (Table 14).

Variable	**Input Values**
Project Domain	Systems Software – Engineering Development (Aircraft Flight Control)
Organizational Domain Expertise	Above Average
Availability of Vendors with Domain Expertise	High
Project Size	10,000 person-months
Project Modularity	Well- defined interfaces
Manpower Constraints	Not enough in-house personnel (and unable to hire required personnel)
Cost Constraints	Cost is a secondary factor (e.g., cost-plus contract)
Schedule Constraints	Current in-house schedule is unacceptable and should be reduced by 15 percent or more to meet deadlines or time-to-market goals
Effort Levels	Effort is distributed across phases in a fashion typical for projects in this domain
Outsourcing Strategy	Keep everything in-house except outsource system-level software testing (100 percent of the testing phase effort)
Prioritized Project Goals	▪ Schedule reduction of 15 percent or greater ▪ Increased product quality ▪ Reduce in-house effort by 30 percent or more ▪ Cost Reduction of 20 percent or more

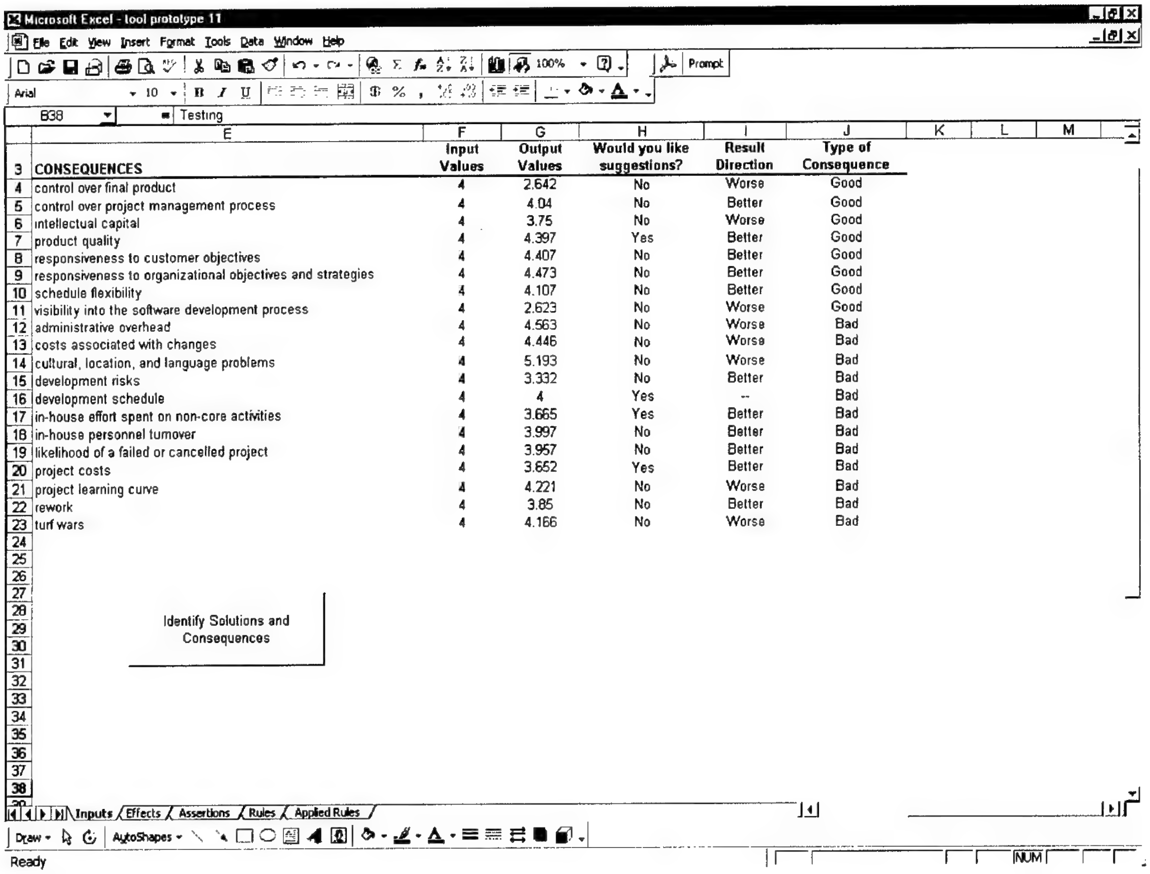
Table 14: Large Embedded Aircraft Software System Use-Case Inputs

As shown in Figure 68, the output of the tool would identify the likelihood of meeting each goal in the prioritized list. The example output is based on a simple, common sense rule and data extracted from published literature. According to Jones, post integration testing (system, field, and acceptance) averages between 7.5 and 13 percent of all software development efforts (C. Jones Applied Software Measurement: Assuring Productivity and Quality). This generalization fits because the project manager

gave the tool input indicating an average work effort distribution across development phases. As a result, outsourcing of the system-level testing effort alone is unlikely to achieve a 15 percent schedule reduction. Figure 68 shows the tool outputs for this scenario. Notice that since the user desires significant improvements in cost, schedule, quality, and in-house effort levels, Column H shows the user requesting further improvement. Once these inputs are entered, the assertions can be activated to identify the suggestions that might improve these consequences (along with potential side-effects of each suggestion). The macro button assigned to executing the assertions is shown in Figure 69.

	E	F	G	H	I
3	CONSEQUENCES	Input Values	Output Values	Would you like suggestions?	Result Direction
4	control over final product	4	2.642	No	Worse
5	control over project management process	4	4.04	No	Better
6	intellectual capital	4	3.75	No	Worse
7	product quality	4	4.397	Yes	Better
8	responsiveness to customer objectives	4	4.407	No	Better
9	responsiveness to organizational objectives and strategies	4	4.473	No	Better
10	schedule flexibility	4	4.107	No	Better
11	visibility into the software development process	4	2.623	No	Worse
12	administrative overhead	4	4.563	No	Worse
13	costs associated with changes	4	4.446	No	Worse
14	cultural, location, and language problems	4	5.193	No	Worse
15	development risks	4	3.332	No	Better
16	development schedule	4	4	Yes	--
17	in-house effort spent on non-core activities	4	3.665	Yes	Better
18	in-house personnel turnover	4	3.997	No	Better
19	likelihood of a failed or cancelled project	4	3.957	No	Better
20	project costs	4	3.652	Yes	Better
21	project learning curve	4	4.221	No	Worse
22	rework	4	3.85	No	Better
23	turf wars	4	4.166	No	Worse

Figure 68: Aircraft Example Tool Outputs



CONSEQUENCES	Input Values	Output Values	Would you like suggestions?	Result Direction	Type of Consequence
control over final product	4	2.642	No	Worse	Good
control over project management process	4	4.04	No	Better	Good
intellectual capital	4	3.75	No	Worse	Good
product quality	4	4.397	Yes	Better	Good
responsiveness to customer objectives	4	4.407	No	Better	Good
responsiveness to organizational objectives and strategies	4	4.473	No	Better	Good
schedule flexibility	4	4.107	No	Better	Good
visibility into the software development process	4	2.623	No	Worse	Good
administrative overhead	4	4.563	No	Worse	Bad
costs associated with changes	4	4.446	No	Worse	Bad
cultural, location, and language problems	4	5.193	No	Worse	Bad
development risks	4	3.332	No	Better	Bad
development schedule	4	4	Yes	--	Bad
in-house effort spent on non-core activities	4	3.665	Yes	Better	Bad
in-house personnel turnover	4	3.997	No	Better	Bad
likelihood of a failed or cancelled project	4	3.957	No	Better	Bad
project costs	4	3.652	Yes	Better	Bad
project learning curve	4	4.221	No	Worse	Bad
rework	4	3.85	No	Better	Bad
turf wars	4	4.166	No	Worse	Bad

Figure 69: Activating the Assertions

Finally, the tool identifies strategy modifications that can improve the projects' ability to meet prioritized goals. One such suggestion could be to outsource a product component to another vendor. Given a large enough chunk of effort, outsourcing a product component apparently has the potential to shorten the overall development schedule. The suggestions are shown in Figure 70.

Suggestion or Situational Variable	Positive Consequences (can improve the following consequences)	Negative Side-Effects (may have these undesirable side-effects)
Outsourcing development of software in a domain familiar to the vendor	development risks	
	likelihood of a failed or cancelled project	
	product quality	
	project learning curve	
Outsourcing development of software in a project domain with many available vendors	project costs	
Outsourcing development of software to a vendor with more experience with tools or languages.	development schedule	
	in-house effort spent on non-core activities	
	project learning curve	
Outsourcing development of software to a vendor with reusable design or code components.	development risks	control over final product
	development schedule	
	project costs	
	project learning curve	
	turf wars	
Outsourcing development of software when the vendor has a successful track record.	development risks	
	likelihood of a failed or cancelled project	
	product quality	

Figure 70: Suggestions for the Example Aircraft Scenario

5.3.2 Deciding Between Alternatives

A consultant for the All-American Bicycle Company was asked to determine the best strategy for acquiring a state-of-the-art accounting system. While the company has an information systems department that develops in-house applications and writes custom code for factory controllers, they are already overworked and have no experience in designing an accounting system. The consultant believes that designing and building a custom accounting system will be expensive and time-consuming and could be better accomplished by an outside vendor. After reviewing the marketplace, the consultant finds three interested companies. The first company sells standard off-the-shelf accounting products – which do not exactly meet corporate process standards, but could possibly be used. The second company sells customizable accounting packages. Finally, the third vendor has vast accounting system development experience and can create a completely custom system while still taking advantage of knowledge and object re-use.

As in the previous example, the consultant enters the project data and goals. Next the consultant runs the decision support tool once for each possible outsourcing strategy and determine which best meets the company's goals.

5.4 Knowledge Base Rules

5.4.1 Project Level Rules

The rules that form the basis of the decision support tool were shown graphically in Section 4.9. The rules also have numerical values representing the coefficients from the regression equations. All of the relevant regression information is shown in Appendix A. The regression technique was chosen over a promising attempt using neural networks. While the neural models performed well, there was no means for ensuring only the significant inputs were included, the network topology was correct, or that over-training did not occur. Additionally, the neural models were not explainable and thus could not provide insight into which factors affect outsourcing consequences and why. The entire table of rules is located in Appendix E. Each rule shows the product, process, and domain factors that impact each consequence as well as the impact coefficient. Figure 71 shows two sample rules from Appendix E. Rule one states that for projects that involve outsourcing both process and product components, manager's can expect a reduction of 0.753 in the consequence of intellectual capital. The regression coefficient (0.753 in this case) comes from the 7-point scale from question ten on the survey instrument and reprinted as Figure 67. Rule one implies that projects that outsource both process and product components experience a slightly lower level of intellectual capital.

Take special notice that rule 16 is composed of constants from the regression equation. These constants indicate the effect any outsourcing has on consequences.

Rule No	Factors (Antecedent)	Consequent	Effect	Impact	Direction
1	Both Process and Product Outsourcing	10. Improved/Increased Intellectual Capital	0.753	Small	Negative (Degrading)
2	Domain - Enterprise	6. Reduced Development Risks	0.885	Small	Positive (Improving)

Figure 71: Outsourcing Rule Sample

Rules 1, 7, 8, 10, 11, 13, 16, 21, and 26 (shown in Appendix E) all concern the consequence of intellectual capital and can be combined to form a single formula from the regression model. The entire rule for the intellectual capital consequent can be written as:

$$
\begin{aligned}
&Intellectual\_Capital(outsourcing) = Intellectual\_Capital(in-house) + 0.826 \\
&\quad -0.753 * (\text{product\_and\_process\_outsourcing}) \\
&\quad +0.867 * (\text{domain\_shrinkwrap\_business}) \\
&\quad -1.265 * (\text{domain\_shrinkwrap\_utilities}) - 1.48 * (\text{domain\_component\_CASEtool}) \\
&\quad +1.04 * (\text{domain\_component\_domain\_framework}) - 0.323 * (\text{domain\_systems}) \\
&\quad -1.299 * (\text{process\_fielding}) + 0.912 * (\text{process\_training})
\end{aligned}
$$

The signs of the coefficients indicate whether the particular factor has a positive or negative effect on the consequence. While increasing intellectual capital is considered an improvement, increases in other consequences such as schedule duration are negative effects. Where *Intellectual_Capital(in-house)* is the expectation of intellectual capital for this project if development were conducted entirely in-house. The remaining variables are defined as:

$$\left.\begin{array}{l}\text{product\_and\_process\_outsourcing}\\ \text{domain\_shrinkwrap\_business}\\ \text{domain\_shrinkwrap\_utilities}\\ \text{domain\_component\_CASEtool}\\ \text{domain\_component\_domain\_framework}\\ \text{domain\_systems}\\ \text{process\_training}\end{array}\right\} \begin{array}{l}\text{1 if True OR}\\ \text{0 if False}\end{array}$$

Each consequence has a similar equation that can be found in the coefficients section of each regression run shown in Appendix A.

5.4.2 General Outsourcing Experience Assertions

Unlike the project level rules, outsourcing assertions were not captured in a numerical form. Analysis of these assertions yielded relationships between types of projects and relationship factors compared with the consequences of outsourcing projects. These relationships were used to produce a table identifying which assertions relate to either improvement (IMP) or worsening (WOR) of each outsourcing consequence. This table is shown in Appendix E.

5.5 Implementation

After experimenting with several implementation platforms, the researcher chose Microsoft Excel for the prototype tool. While *CLIPS* and *FuzzyClips* provided excellent knowledge base features, their text-based interface would have required an extensive graphical shell to make the tool user friendly. The final implementation uses both the spreadsheet and Visual Basic macro features of Microsoft Excel.

5.6 Tool Usage

This tool is intended to provide project managers with a means to plan outsourcing projects and gauge expectations based on each particular project scenario. To accomplish this goal, the decision support tool was constructed in two parts. First, managers enter their software domain, product type, and select which processes they plan to outsource. From that information the tool uses straightforward spreadsheet functions to calculate the expected outcomes of the software project as an offset of the user's expectations for an in-house project. These spreadsheet functions are precise implementations of the statistical rules discussed in the previous section. At any time, a user may choose different outsourcing strategies (processes and products types) and immediately see the expected changes in the project consequences.

Once a final set of outsourced processes and product types have been reached, a user can compare the consequences with their needs and goals. If the consequences are not yet satisfactory, the user can pick those consequences that require further improvement and execute a macro to activate solutions that will improve those specific consequences. The macro produces a list of suggestions with their associated benefits and drawbacks. The suggestions come from the survey assertions shown in Appendix D.

5.7 Decision Support Tool Summary

The decision support tool presented in this chapter implements the outsourcing rules-of-thumb and assertions (shown in Chapter 4) as an inference engine to transform project scenario variables into expectations for outsourcing consequences that were considered important by survey respondents. The tool inputs, outputs, and rules are all

drawn directly from survey analysis. The usage scenarios mirror the needs of decision makers as found in Section 4.4. Chapter 6 presents the effort necessary to demonstrate the tool and its underling framework were valid and non-trivial.

6. *Decision Support Tool and Framework Validation*

This section outlines the methods and results of the validation effort. The validation consisted of comparisons between tool outputs and both expert and novice expectations for four project scenarios. In addition, a well-known software outsourcing consultant from the Cutter Consortium Sourcing Service was asked to review the outsourcing rules and assertions to compare them with his vast experience.

6.1 Decision Support Tool Validation Literature

Bahill defined decision support system validation as "building the right system: that is writing specification and checking performance to make sure that the system does what it is supposed to do" (Bahill). Hayes-Roth et al. suggested four evaluation principles:

1. Complex objects or processes cannot be evaluated by a single criterion or number.
2. The larger the number of distinct criteria evaluated or measurements taken, the more information will be available on which to base an overall evaluation.
3. People will disagree about the relative significance of various criteria according to their respective interests.
4. Anything can be measured experimentally as long as exactly how to take the measurements is defined. (Hayes-Roth, Waterman and Lenat)

While testing, verification and some validation techniques are appropriate, Hayes-Roth et al. explained that blind comparison test between decision support tool outputs and other expert results are not typically appropriate.

The most frequently discussed validation technique is evaluation by peers. Whether the peer expert evaluators were involved with system development is the biggest validation methodology decision. While any expert can validate the knowledge within a decision support system, outside experts can also help validate whether the system

answers the right problems (Hayes-Roth, Waterman and Lenat). Hayes-Roth finally suggested that "the true goal of evaluation should not be to show how well a system does what it was designed to do but, rather, to gain a greater appreciation of the process, structure, and limits of expertise."

According to Ayel, decision support tool validation is most frequently performed by the same experts used to define the original system (Ayel and Laurent). The results of his research are shown in Table 15.

Percentage	Job Category
29.6	Same expert from whom knowledge was gathered
20.3	Knowledge engineer
20.1	Different expert than from whom the knowledge was gathered
12.4	End user
9.5	"Sponsor" of the project
7.5	Independent validator
0.3	"Other"

Table 15: Typical Sources of Decision Support Tool Validators

In addition, Ayel's study shows that testing a decision support tool versus actual data represents the most prevalent validation effort and is also the most effective technique. The second most effective and common validation practice is to test the system with contrived data (Ayel and Laurent). Both of these approaches were part of the validation effort for this research.

Payne states that specific test cases should be developed and presented to both the prototype decision support tool and validation experts. Upon completion, the "correct" expert answers must be compared to the results of the decision support tool. Where substantial differences exist between the answers, developers should consider entering new rules to the knowledge base (Payne and McArthur).

Adelmen identified structural and behavioral comparisons for decision support tool validation. Structural comparisons focus on evaluating the similarities in how knowledge base and the non-design subject matter experts conceptualize and structurally represent knowledge." Behavioral comparisons "focus on evaluating the similarity and accuracy of the predictions made by the knowledge base and non-design subject matter experts for test cases." (Adelman and Riedel)

These structural comparisons are typically performed by a decision support tool developer (design subject matter experts) while behavioral comparisons are performed by domain experts who may or may not have been involved in the knowledge base creation. Adelmen suggests three to five validation experts as ideal for decision support tool validation and points out that one or two validation experts can be used if the test cases are well-crafted to cover the system requirements (Adelman and Riedel).

Parsaye points out that "some of the techniques for verifying and validating simulation models are also useful in testing and simulating the operation of an expert system." (Parsaye and Chignell) This parallel between decision support tool and simulation model validation means that previous validations of simulations and decision support tools such as systems dynamic modeling by Tvedt, Rus, and Ma are comparable to this validation effort (Ma ; Tvedt ; Rus). These researchers used two, four, and four validation experts – falling within the range recommended by Adelman.

In some domains with a small number of clearly world-class experts, identifying experts for knowledge acquisition and system validation can be simple (Payne and McArthur). However in many fields, experts do not exist with experience in all required

areas. Software development with its many domains and sub domains is one such area. Experts are distinguished by their procedural knowledge – finding and fixing problems. This knowledge can be deeply theoretical or practical, hands-on experience (Payne and McArthur).

6.2 Validation Methodology

The final, important step to complete the research effort was to ensure the model correctly captures outsourcing experience and recommends appropriate outsourcing strategies given project constraints.

6.2.1 Performance Validation – Expert Consensus

After completion of the model and decision support system, experts were asked to validate the model's structure, rules, and appropriateness of outsourcing strategy suggestions for various project scenarios. Any changes were used to further refine the model and decision support tool. Experts were defined as software project managers with at least five years of outsourcing experience encompassing at least 10 development projects. Outsourcing consultants and authors were also asked to review the tool and framework.

Experts should generally agree on results of test scenarios. A consensus and close agreement with the decision support tool indicates a successful performance validation. Comments and differences were reviewed to produce new candidate rules or change/eliminate existing rules. Twelve experienced software development outsourcers were selected to determine consensus for test scenarios.

Experts were asked to review four evaluation test scenarios to cover each major software domain. Product and process outsourcing were varied to cover the maximum number of existing rules with emphasis on the most prevalent outsourcing strategies. These same scenarios were used for both the expert consensus and usefulness evaluation.

6.2.2 Usefulness Evaluation

Novices were asked to predict outsourcing consequence for the same evaluation scenarios as the experts. Comparison of the novice results to experts' results and tool outputs showed that the knowledge base rules are not simply intuitive as evidenced by a lack of strong consensus among the novice predictions and lower level of success matching the novice predictions and tool outputs. Twelve inexperienced software development outsourcers were selected, each with experience on no more than one outsourcing software development project.

6.3 Validation Results

6.3.1 Scenario Selection and Rule Coverage

Four contrived outsourcing scenarios were developed for both the performance and usefulness evaluations. The scenarios were developed to achieve the most complete coverage of domains, processes, and outsourcing product types in balance with a need to not overwhelm validation respondents. The scenarios can be found within the validation package included as Appendix F. Together, the scenarios exercise 25 different rules from the total of 30 outsourcing decision support rules found during this research effort. Since each scenario involves outsourcing, all used the outsourcing constants found in decision

rule number 16. Rules 19 and 25 were each used twice, while rules four, five, 11, 12, and 15 were not used in any of the scenarios. A complete list of outsourcing rules can be found in Appendix E.

6.3.2 Performance Validation – Expert Consensus

Six experts reviewed four outsourcing scenarios and estimated the consequences of each scenario based upon the same inputs required by the decision support tool. In several cases, experts assumed additional facts about the scenario that could cause confusion. This researcher was able to eliminate this confusion by using the assertion rules from the outsourcing tool to account for changes in specific consequences related to the expert's assumptions. Tool outputs, expert responses, and comparison data can be found in Appendix G.

The expert estimates were compared directly with the decision support tool outputs for each scenario. Each tool output is a specific number that fits in the continuous range from one to seven. The experts responded using the same scale from the original survey and is shown in Figure 67. To account for the larger granularity of the survey response scale, each tool output was given a plus or minus range of one and then compared to the experts responses. A response was considered a match if it fell within the range of the tool output. Experts matched 73 percent of the tool outputs across the four validation scenarios. The expert success was consistent across all projects with no averages below 70 percent. The results for this validation analysis are shown in Table 16.

Much like the overall averages, each expert was consistent in their success in matching the tool outputs. No expert average fell below 68 percent. A second analysis compared the tool outputs and expert responses on the basis of whether the responses predicted the consequence in the same direction. This criterion is can be defined by example. If the tool predicts an increase for a consequence, an expert response is a match if it also predicts and improvement. When this looser criterion is applied, expert success in matching the tool outputs increased to 85 percent as shown in Table 17.

With a Delta Range of 1 on 7 Point Scale					
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Average**
Expert	70%	78%	74%	71%	73%
Novice	48%	52%	43%	45%	47%
Difference	22%	26%	32%	26%	27%

Table 16: Validation Consensus by Range

Matching Sign (Improve/Degrade/Neutral)					
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Average**
Expert	83%	87%	86%	85%	85%
Novice	63%	66%	58%	71%	65%
Difference	20%	21%	29%	14%	21%

Table 17:Validation Consensus by Direction

6.3.3 Usefulness Evaluation

Seven novice software outsourcing professionals were asked to complete the same four scenarios as the six experts described in Section 6.3.2 above. Table 16 shows the results of the range-based comparison between novice and expert responses and the decision support tool outputs. Table 17 shows the same analysis with the looser criterion of matching direction between expert and novice responses and the decision support tool outputs.

The tool can be considered useful since the tool outputs match the expert responses significantly better than novice responses. This result implies the decision support tool and its knowledge base rules are not simply intuitive information. To conclusively demonstrate significance, the success rates for every completed scenario were divided into those performed by experts and those from novices. Since the overall average for the novice validators was 47 percent, each set was compared to 50 percent. The results of these one-sample T-tests are shown in and described in section 4.8. Using the same Bonferroni correction, the novice responses were not significantly different from the 0.5 (50 percent) value while the expert values were significantly different beyond the 95 percent confidence level.

Test Value = 0.5				
	t	df	Sig. (2-tailed)	Mean Difference
EXPERT	12.61027	18	2.26E-10	0.237895
NOVICE	-0.89424	13	0.387452	-0.03429

Table 18: Comparison of Novice and Expert Success Rates

6.3.4 Expert Review

Three experts agreed to review the internal rules and assertions that comprise the decision support tool. Only Mr. Mike Epner completed the review, comparing the rule base structure and with his experiences. He is a Process Improvement Director with TeraQuest Metrics, Inc., providers of strategic consulting, assessments, and training for organizations that build or acquire software intensive systems. Mr. Epner specializes in software acquisition management, assisting Fortune 500 companies as well as emerging companies with their outsourcing practices. His projects have spanned diverse industries including medical, telecommunication, e-commerce, and transportation, and have

involved multi-billion dollar outsourcing agreements. Prior to joining TeraQuest, he was Director of Quality Services at Eastman Kodak Company where he led the quality assurance, test, configuration management and systems integration activities for two medical software divisions. His responsibilities included the specification and integration of outsourced software systems for enterprise telemedicine configurations. Mr. Epner has authored articles on software process improvement for Cutter IT Journal, Quality Observer and Medical Software Weekly. He recently completed a 2-year term as Regional Councilor for the American Society for Quality's Software Division.

Mr. Epner's validation review summary is presented in Table 19 below.

Mike Epner Review		
Consequence	**Agreement**	**Comments**
1. Administrative Overhead – Rules	Yes	
Administrative Overhead – Assertions	Yes	
2. Control Over Final Product – Rules	Yes	
Control Over Final Product – Assertions	Yes	
3. Control Over Outsourced Project Management Process – Rules	Not Sure	I don't see why custom vs. customized common implies less control. Perhaps it's more than management processes but business processes that are being considered by those surveyed? Buyers are often forced to use business processes based on the customized app vs. defining the app to meet business need in the custom case. I am OK with the other rules.
Control Over Outsourced Project Management Process – Assertions	Yes	Makes sense. I find it interesting that payment strategies and incentives are not a factor in control as that is often the motivation for employing them.

Mike Epner Review		
Consequence	**Agreement**	**Comments**
4. Costs Associated with Changes – Rules	Yes	
Costs Associated with Changes – Assertions	Yes	Very much so. The vendor is likely squeezed already in situations where there are cost schedule pressures. Changes essentially 'open the valve.'
5. Cultural, Location, and Language Problems – Rules	Yes	
Cultural, Location, and Language Problems – Assertions	Yes	
6. Development Risks – Rules	Yes	
Development Risks – Assertions	Yes	I would have expected maturity of the vendor to reduce risk
7. Development Schedule Duration – Rules	No	I'm not sure what we are comparing here. Clearly, if I outsource and use a COTS solution (or even customized COTS), it SHOULD result in reduced development time vs. starting from scratch. That is often a motivation for engaging a vendor as you state. If we are comparing COTS implemented with a vendor vs. internally, then there probably is no significant reduction and the conclusion holds, though it's not particularly useful.
Development Schedule Duration – Assertions	Yes	
8. In-House Effort Spent on Non-Core Activities – Rules	Yes	
In-House Effort Spent on Non-Core Activities – Assertions	Yes	
9. In-House Personnel Turnover – Rules	Yes	

Mike Epner Review		
Consequence	**Agreement**	**Comments**
In-House Personnel Turnover – Assertions	Yes	I would expect the level/rate of outsourcing to play a factor. If a large percentage of new projects are outsourced, in-house turnover will likely increase. Also, if management does not communicate how the organization is evolving and provide technical growth paths (ie, non-maintenance focused opportunities), turnover will increase.
10. Intellectual Capital – Rules	Yes	This finding is consistent with my experience and I agree that it is surprising. In many cases, buyers have negotiated all rights, in others; they don't realize the impact of the rights that they have given up until later.
Intellectual Capital – Assertions	Not Sure	I have seen buyers relinquish rights for pricing/cost concessions.
11. Likelihood of Failed or Cancelled Project – Rules	Yes	
Likelihood of Failed or Cancelled Project – Assertions	Not Sure	Decreased likelihood of failure if far apart is certainly not intuitive. This directly contradicts 1.5 and 1.16 to some degree. Distance does usually drive better requirements so it could be that that compensates for the other inherent risks/problems.
12. Product Quality – Rules	Yes	
Product Quality – Assertions	Yes	No impact of CMM level on quality? Interesting.
13. Project Costs – Rules	Yes	
Project Costs – Assertions	Yes	

Mike Epner Review		
Consequence	**Agreement**	**Comments**
14. Project Learning Curve – Rules	No	I'm confused by this. many organizations outsource because they lack the skills and cannot afford the learning curve. Outsourcing supplants the learning curve with personnel skilled in the project area and shortens the learning curve by virtue of its instantiation in any of the product/domain areas.
Project Learning Curve – Assertions	Yes	
15. Responsiveness to Customer Objectives – Rules	Yes	
Responsiveness to Customer Objectives – Assertions	Yes	
16. Responsiveness to Organizational Objectives – Rules	Yes	
Responsiveness to Organizational Objectives – Assertions	Yes	Yep, as buyers increase the pressure on cost and schedule, vendors cannot fit changes and 'other' activities not originally considered. Results in perceived lack of responsiveness.
17. Rework – Rules	Yes	
Rework – Assertions	Yes	
18. Schedule Flexibility – Rules	Not Sure	I don't see an obvious reason why this domain is different from the others.
Schedule Flexibility – Assertions	Yes	
19. Turf Wars – Rules	Yes	
Turf Wars – Assertions	Yes	
20. Visibility into the Software Development Process – Rules	Yes	
Visibility into the Software Development Process – Assertions	Yes	

Table 19: Mike Epner Validation Review Summary

Mr. Epner disagreed with only two of the twenty rules. The first disagreement concerns the development schedule duration consequence. He presents a well-taken argument that COTS outsourcing should correspond to reduced schedule duration. This relationship between COTS outsourcing and schedule duration was a research hypothesis prior to the survey, but not borne out by the statistical analysis. The second disagreement concerned project learning curve. Mr. Epner points out that a great deal of outsourcing is undertaken to acquire expertise not available in-house, but did not mention that for some projects in-house personnel shortages drive the outsourcing decision. In these cases, we might expect in-house personnel to have more domain expertise than vendor personnel – thus increasing the learning curve. Mr. Epner did not, however, disagree with the notion that Order Entry Systems might correspond with reduced project learning curves. Mr. Epner's comments in the review suggest several new assertions to add to the decision support tool (Table 20).

Factor	**Consequence**
Vendor Maturity	Development Risks (IMP)
COTS Product Outsourcing	Development Schedule (IMP)
Level of Outsourcing	In-House Personnel Turnover (WOR)

Table 20: Suggested Additional Assertions

Overall this quality review validated the rules and assertions built into the decision support tool. The statistically arrived-upon rules are understandable and match this expert's experience. Based upon his recommendations, the three new assertions were added to the tool and Appendix D.

6.4 Validation Summary

The validation effort was successful by all measures. Expert responses closely matched tool outputs indicating quality performance. Novice responses failed to match expert performance indicating the knowledge base contains rules that are not simply intuitive. Finally, expert review of the rule structure indicated strong agreement with the rules demonstrating they are understandable and match reviewer experience where applicable. Given this successful validation, Chapter 7 summarizes the conclusions that can be made from this research effort, contributions the research makes to understanding software outsourcing, and several future directions which can further build upon this research.

7. *Conclusions, Contributions, and Future Work*

7.1 Conclusions

This research effort stemmed from a need to better understand why and how outsourcing is currently being used in software development and finding ways to improve a manager's abilities to select appropriate outsourcing courses-of-action. Chapter 2 presented the concepts of an outsourcing strategy and previously published outsourcing literature. Since this literature fails to meet the research goals, a plan for meeting the goals was presented in Chapter 3. The survey methodology, statistical analysis, decision support tool development, and validation effort established credibility for the research methodology and results. Chapter 4 presented the results of the outsourcing survey and statistical analysis. In addition to producing decision support rules, outsourcing goals and demographics expand the largely anecdotal nature of previous software development literature. The prototype decision support tool rules, implementation, and usage are shown in Chapter 5. Finally, extensive validation results demonstrate the impressive performance of the outsourcing rules and framework (Chapter 6).

7.2 Contributions

7.2.1 Outsourcing Demographics

The research results presented information about how much software development outsourcing is occurring and who within software development organizations make outsourcing decisions. While this information cannot be assumed to generalize beyond the sample population, its breadth is considerably larger than that of

most individuals. The context of a broad survey covering all major software development domains differentiates this study from most software outsourcing literature that is typically the result of an individual author's consulting experience. While the smaller individual-level picture is valid and helpful to a consultant's clients, a broader study of the software domain provides a better basis for developing a software outsourcing framework.

7.2.2 Outsourcing Strategies

A primary goal of this research was to determine how software domains, outsourced processes, and product types affect software outsourcing project consequences. These three factors define a software outsourcing strategy as discussed in Chapters 2 and 3. No other published work discusses types of outsourcing strategies at the project level – selecting which process and product components to outsource for a specific project. Finally, this study expanded all previous software outsourcing literature that focused on a single software domain or a few related software domains.

7.2.3 Outsourcing Goals

Most authors and practitioners assumed that outsourcing of software development occurs primarily to reduce costs, reduces schedule durations, or to offload development effort due to in-house personnel shortages. This study identified fourteen significant outsourcing goals and showed that many of these goals are more significant than the three frequently published goals.

7.2.4 Outsourcing Framework

The central goal of this research effort was to determine how software domains, process components outsourced, and product component types outsourced affect the outcomes of software development outsourcing projects. The statistical analysis of survey responses yielded 30 significant rules that define how these factors affect outsourcing projects. This work is new in terms of content and unusual in its technique for capturing knowledge. Most knowledge base data collected for decision support tools is collected from a single expert. Many software researchers collect survey data to develop expert systems, but few use statistical techniques to distill the information. Most, manually collate data to find patterns – a technique prone to researcher bias and error. This analysis used statistical regression and sampling techniques to discover the software outsourcing rules. The ability to easily explain these statistically discovered rules lends additional credibility to this work.

7.2.5 Decision Support Tool

The prototype decision support tool should be interesting to software development managers, consultants, management academics, and software engineering academics. The fully-populated and validated tool can be used in industry, expanded for new strategies and additional scenarios, used as a front-end for a modeling analysis of outsourcing, and studied as a method for making other software management decisions. This research effort has generated interested from academic, industrial, and government practitioners.

7.3 Future Work

7.3.1 Software Outsourcing Modeling

As previously mentioned, Steve Roehling, a Master's student at Arizona State University, has developed the first systems dynamics modeling simulation of an outsourcing relationship. The decision rules from this knowledge base are factors that affect the consequences of outsourcing projects. These rules can become inputs to future simulation models to expand the ability to study additional consequences and strategies.

7.3.2 Expand Outsourcing Rules and Assertions

While the decision support rules are an important first step, this researcher realizes they are not necessarily complete. In some cases, the regression models in Appendix A explain less than 50 percent of the variance for specific outsourcing consequences. Other factors such as those studied in the 'assertions' section of the survey should be quantified and added to the overall model. This expansion will take anecdotal evidence from the literature and the qualitative survey assertions from this study and develop new and additional rules that explain more completely the consequences of specific outsourcing projects. While this research effort studied projects in nearly all software development domains, some information such as the bureaucratic nature of software projects (military, government, or commercial applications) and geographical factors were not specifically captured or analyzed.

7.3.3 Automate Knowledge Base Creation and Updating

As mentioned in Section 5.5, several knowledge base creation environments are available. These systems allow decision tool developers to easily change rules based on new research and encapsulate rule implementation from tool functionality. While this study was intended to prototype the tool concept, and most importantly baseline the outsourcing decision rule data, future development should focus on tool robustness, modularity, and expandability.

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Appendix A: Regression for Outsourcing Consequences

Regression

Warnings

For models with dependent variable consequence_admin_overhead, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-documentation	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	enterprise-manufact	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	shrink-utilities	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_admin_overhead

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.268[a]	.072	.060	1.2526	.072	6.055	1	78	.016
2	.400[b]	.160	.138	1.1994	.088	8.083	1	77	.006
3	.464[c]	.215	.184	1.1669	.055	5.347	1	76	.023

a. Predictors: (Constant), whatprocess-documentation

b. Predictors: (Constant), whatprocess-documentation, enterprise-manufact

c. Predictors: (Constant), whatprocess-documentation, enterprise-manufact, shrink-utilities

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.500	1	9.500	6.055	.016[a]
	Residual	122.387	78	1.569		
	Total	131.888	79			
2	Regression	21.126	2	10.563	7.343	.001[b]
	Residual	110.761	77	1.438		
	Total	131.888	79			
3	Regression	28.407	3	9.469	6.954	.000[c]
	Residual	103.481	76	1.362		
	Total	131.888	79			

a. Predictors: (Constant), whatprocess-documentation

b. Predictors: (Constant), whatprocess-documentation, enterprise-manufact

c. Predictors: (Constant), whatprocess-documentation, enterprise-manufact, shrink-utilities

d. Dependent Variable: consequence_admin_overhead

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.621	.154		29.971	.000
	whatprocess-documentation	-.907	.369	-.268	-2.461	.016
2	(Constant)	4.621	.148		31.303	.000
	whatprocess-documentation	-1.160	.364	-.343	-3.187	.002
	enterprise-manufact	3.538	1.245	.306	2.843	.006
3	(Constant)	4.563	.146		31.280	.000
	whatprocess-documentation	-1.101	.355	-.326	-3.101	.003
	enterprise-manufact	3.538	1.211	.306	2.922	.005
	shrink-utilities	1.938	.838	.236	2.312	.023

a. Dependent Variable: consequence_admin_overhead

Regression

Warnings

For models with dependent variable consequence_change_costs, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	component-OS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_change_costs

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.225[a]	.050	.038	1.2352	.050	4.088	1	77	.047

a. Predictors: (Constant), component-OS

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.238	1	6.238	4.088	.047[a]
	Residual	117.484	77	1.526		
	Total	123.722	78			

a. Predictors: (Constant), component-OS

b. Dependent Variable: consequence_change_costs

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.446	.144		30.963	.000
	component-OS	1.154	.571	.225	2.022	.047

a. Dependent Variable: consequence_change_costs

Regression

Warnings

For models with dependent variable consequence_control_process, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-design	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-reengineering	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	COMPONENT	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	whatproducts-common-cust	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_control_process

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.326[a]	.106	.095	1.4440	.106	9.273	1	78	.003
2	.455[b]	.207	.186	1.3690	.101	9.787	1	77	.002
3	.514[c]	.264	.235	1.3277	.057	5.864	1	76	.018
4	.557[d]	.310	.274	1.2935	.047	5.068	1	75	.027

a. Predictors: (Constant), whatprocess-design

b. Predictors: (Constant), whatprocess-design, whatprocess-reengineering

c. Predictors: (Constant), whatprocess-design, whatprocess-reengineering, COMPONENT

d. Predictors: (Constant), whatprocess-design, whatprocess-reengineering, COMPONENT, whatpr

ANOVA[e]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.337	1	19.337	9.273	.003[a]
	Residual	162.651	78	2.085		
	Total	181.987	79			
2	Regression	37.679	2	18.839	10.052	.000[b]
	Residual	144.309	77	1.874		
	Total	181.987	79			
3	Regression	48.016	3	16.005	9.080	.000[c]
	Residual	133.972	76	1.763		
	Total	181.987	79			
4	Regression	56.496	4	14.124	8.441	.000[d]
	Residual	125.491	75	1.673		
	Total	181.987	79			

a. Predictors: (Constant), whatprocess-design

b. Predictors: (Constant), whatprocess-design, whatprocess-reengineering

c. Predictors: (Constant), whatprocess-design, whatprocess-reengineering, COMPONENT

d. Predictors: (Constant), whatprocess-design, whatprocess-reengineering, COMPONENT, whatproducts-common-cust

e. Dependent Variable: consequence_control_process

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.368	.331		13.186	.000
	whatprocess-design	-1.155	.379	-.326	-3.045	.003
2	(Constant)	4.169	.320		13.011	.000
	whatprocess-design	-1.184	.360	-.334	-3.290	.002
	whatprocess-reengineering	1.261	.403	.318	3.128	.002
3	(Constant)	4.556	.349		13.038	.000
	whatprocess-design	-1.367	.357	-.386	-3.829	.000
	whatprocess-reengineering	1.407	.395	.355	3.559	.001
	COMPONENT	-.779	.322	-.246	-2.422	.018
4	(Constant)	4.829	.361		13.364	.000
	whatprocess-design	-1.465	.351	-.413	-4.178	.000
	whatprocess-reengineering	1.336	.387	.337	3.455	.001
	COMPONENT	-.802	.314	-.254	-2.557	.013
	whatproducts-common-cust	-.789	.350	-.218	-2.251	.027

a. Dependent Variable: consequence_control_process

Regression

Warnings

For models with dependent variable consequence_control_product, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatproducts-common-cust	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-maintenance	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_control_product

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.307[a]	.094	.083	1.2493	.094	8.105	1	78	.006
2	.383[b]	.146	.124	1.2205	.052	4.722	1	77	.033

a. Predictors: (Constant), whatproducts-common-cust

b. Predictors: (Constant), whatproducts-common-cust, whatprocess-maintenance

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.650	1	12.650	8.105	.006[a]
	Residual	121.738	78	1.561		
	Total	134.388	79			
2	Regression	19.684	2	9.842	6.607	.002[b]
	Residual	114.704	77	1.490		
	Total	134.388	79			

a. Predictors: (Constant), whatproducts-common-cust

b. Predictors: (Constant), whatproducts-common-cust, whatprocess-maintenance

c. Dependent Variable: consequence_control_product

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.934	.160		24.597	.000
	whatproducts-common-cust	-.934	.328	-.307	-2.847	.006
2	(Constant)	3.722	.184		20.179	.000
	whatproducts-common-cust	-1.080	.328	-.354	-3.296	.001
	whatprocess-maintenance	.618	.285	.234	2.173	.033

a. Dependent Variable: consequence_control_product

Regression

Warnings

For models with dependent variable consequence_costs, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	component-CASE	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatproducts-custom	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	enterprise-manufact	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_costs

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.319[a]	.102	.090	1.3834	.102	8.957	1	79	.004
2	.433[b]	.187	.166	1.3243	.085	8.204	1	78	.005
3	.501[c]	.251	.222	1.2795	.064	6.561	1	77	.012

a. Predictors: (Constant), component-CASE

b. Predictors: (Constant), component-CASE, whatproducts-custom

c. Predictors: (Constant), component-CASE, whatproducts-custom, enterprise-manufact

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.142	1	17.142	8.957	.004[a]
	Residual	151.179	79	1.914		
	Total	168.321	80			
2	Regression	31.529	2	15.765	8.989	.000[b]
	Residual	136.792	78	1.754		
	Total	168.321	80			
3	Regression	42.270	3	14.090	8.607	.000[c]
	Residual	126.051	77	1.637		
	Total	168.321	80			

a. Predictors: (Constant), component-CASE

b. Predictors: (Constant), component-CASE, whatproducts-custom

c. Predictors: (Constant), component-CASE, whatproducts-custom, enterprise-manufact

d. Dependent Variable: consequence_costs

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.436	.157		28.320	.000
	component-CASE	-2.436	.814	-.319	-2.993	.004
2	(Constant)	3.792	.270		14.027	.000
	component-CASE	-2.722	.786	-.357	-3.465	.001
	whatproducts-custom	.931	.325	.295	2.864	.005
3	(Constant)	3.652	.267		13.690	.000
	component-CASE	-2.722	.759	-.357	-3.587	.001
	whatproducts-custom	1.070	.319	.339	3.359	.001
	enterprise-manufact	3.348	1.307	.256	2.561	.012

a. Dependent Variable: consequence_costs

Regression

Warnings

For models with dependent variable consequence_cult_location_lang_p, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	shrink-utilities	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	COMPONENT	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	systems-avionics	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_cult_location_lang_p

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.315[a]	.099	.087	.7503	.099	8.344	1	76	.005
2	.425[b]	.181	.159	.7203	.082	7.473	1	75	.008
3	.484[c]	.234	.203	.7011	.053	5.168	1	74	.026

a. Predictors: (Constant), shrink-utilities

b. Predictors: (Constant), shrink-utilities, COMPONENT

c. Predictors: (Constant), shrink-utilities, COMPONENT, systems-avionics

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.698	1	4.698	8.344	.005[a]
	Residual	42.789	76	.563		
	Total	47.487	77			
2	Regression	8.575	2	4.287	8.264	.001[b]
	Residual	38.912	75	.519		
	Total	47.487	77			
3	Regression	11.115	3	3.705	7.538	.000[c]
	Residual	36.372	74	.492		
	Total	47.487	77			

a. Predictors: (Constant), shrink-utilities

b. Predictors: (Constant), shrink-utilities, COMPONENT

c. Predictors: (Constant), shrink-utilities, COMPONENT, systems-avionics

d. Dependent Variable: consequence_cult_location_lang_p

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.447	.086		51.671	.000
	shrink-utilities	1.553	.538	.315	2.889	.005
2	(Constant)	4.603	.100		45.857	.000
	shrink-utilities	1.634	.517	.331	3.161	.002
	COMPONENT	-.474	.173	-.286	-2.734	.008
3	(Constant)	4.573	.099		46.393	.000
	shrink-utilities	1.693	.504	.343	3.361	.001
	COMPONENT	-.532	.171	-.322	-3.119	.003
	systems-avionics	.746	.328	.234	2.273	.026

a. Dependent Variable: consequence_cult_location_lang_p

Regression

Warnings

For models with dependent variable consequence_failure_likelihood, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-toolsuppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-CM	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	whatprocess-SWEngSuppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_failure_likelihood

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.294[a]	.087	.075	1.3377	.087	7.301	1	77	.008
2	.429[b]	.184	.162	1.2728	.097	9.059	1	76	.004
3	.475[c]	.225	.194	1.2483	.041	4.006	1	75	.049

a. Predictors: (Constant), whatprocess-toolsuppt

b. Predictors: (Constant), whatprocess-toolsuppt, whatprocess-CM

c. Predictors: (Constant), whatprocess-toolsuppt, whatprocess-CM, whatprocess-SWEngSuppt

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.065	1	13.065	7.301	.008[a]
	Residual	137.796	77	1.790		
	Total	150.861	78			
2	Regression	27.741	2	13.870	8.562	.000[b]
	Residual	123.120	76	1.620		
	Total	150.861	78			
3	Regression	33.983	3	11.328	7.269	.000[c]
	Residual	116.878	75	1.558		
	Total	150.861	78			

a. Predictors: (Constant), whatprocess-toolsuppt

b. Predictors: (Constant), whatprocess-toolsuppt, whatprocess-CM

c. Predictors: (Constant), whatprocess-toolsuppt, whatprocess-CM, whatprocess-SWEngSuppt

d. Dependent Variable: consequence_failure_likelihood

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.952	.170		23.259	.000
	whatprocess-toolsuppt	.990	.366	.294	2.702	.008
2	(Constant)	4.090	.168		24.336	.000
	whatprocess-toolsuppt	1.717	.424	.511	4.049	.000
	whatprocess-CM	-1.228	.408	-.380	-3.010	.004
3	(Constant)	3.957	.178		22.245	.000
	whatprocess-toolsuppt	1.392	.447	.414	3.116	.003
	whatprocess-CM	-1.324	.403	-.409	-3.285	.002
	whatprocess-SWEngSuppt	.689	.344	.234	2.001	.049

a. Dependent Variable: consequence_failure_likelihood

Regression

Warnings

For models with dependent variable consequence_inhouse_non_core, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	enterprise-web	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatproducts-COTS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_inhouse_non_core

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.283[a]	.080	.068	1.2399	.080	6.605	1	76	.012
2	.373[b]	.139	.116	1.2071	.059	5.185	1	75	.026

a. Predictors: (Constant), enterprise-web

b. Predictors: (Constant), enterprise-web, whatproducts-COTS

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.154	1	10.154	6.605	.012[a]
	Residual	116.833	76	1.537		
	Total	126.987	77			
2	Regression	17.708	2	8.854	6.077	.004[b]
	Residual	109.279	75	1.457		
	Total	126.987	77			

a. Predictors: (Constant), enterprise-web

b. Predictors: (Constant), enterprise-web, whatproducts-COTS

c. Dependent Variable: consequence_inhouse_non_core

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.833	.153		25.117	.000
	enterprise-web	1.000	.389	.283	2.570	.012
2	(Constant)	3.665	.166		22.073	.000
	enterprise-web	1.102	.381	.312	2.890	.005
	whatproducts-COTS	.795	.349	.246	2.277	.026

a. Dependent Variable: consequence_inhouse_non_core

Regression

Warnings

For models with dependent variable consequence_inhouse_turnover, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	component -CASE	.	Stepwise (Criteria: Probabilit y-of-F-to-e nter <= .050, Probabilit y-of-F-to-r emove >= .100).
2	whatproce ss-SWEng Suppt	.	Stepwise (Criteria: Probabilit y-of-F-to-e nter <= .050, Probabilit y-of-F-to-r emove >= .100).

a. Dependent Variable: consequence_inhouse_turnover

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.410[a]	.168	.157	.6139	.168	15.559	1	77	.000
2	.458[b]	.210	.189	.6023	.042	3.999	1	76	.049

a. Predictors: (Constant), component-CASE

b. Predictors: (Constant), component-CASE, whatprocess-SWEngSuppt

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.864	1	5.864	15.559	.000[a]
	Residual	29.022	77	.377		
	Total	34.886	78			
2	Regression	7.315	2	3.658	10.082	.000[b]
	Residual	27.571	76	.363		
	Total	34.886	78			

a. Predictors: (Constant), component-CASE

b. Predictors: (Constant), component-CASE, whatprocess-SWEngSuppt

c. Dependent Variable: consequence_inhouse_turnover

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.092	.070		58.108	.000
	component-CASE	-1.425	.361	-.410	-3.944	.000
2	(Constant)	3.997	.084		47.695	.000
	component-CASE	-1.427	.355	-.410	-4.024	.000
	whatprocess-SW EngSuppt	.288	.144	.204	2.000	.049

a. Dependent Variable: consequence_inhouse_turnover

Regression

Warnings

For models with dependent variable consequence_intellectual_capital, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Appendix A: Regression for Outsourcing Consequences

Variables Entered/Removed [a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-fielding	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-training	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	SYSTEMS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	BOTH P&P	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	component-domain	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	shrink-business	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
7	component-CASE	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
8	shrink-utilities	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_intellectual_capital

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.387[a]	.150	.139	.9439	.150	13.563	1	77	.000
2	.469[b]	.220	.200	.9097	.071	6.887	1	76	.010
3	.528[c]	.279	.250	.8807	.059	6.093	1	75	.016
4	.567[d]	.322	.285	.8599	.043	4.672	1	74	.034
5	.599[e]	.359	.315	.8417	.037	4.231	1	73	.043
6	.631[f]	.398	.347	.8216	.039	4.621	1	72	.035
7	.678[g]	.459	.406	.7838	.062	8.117	1	71	.006
8	.702[h]	.492	.434	.7650	.033	4.535	1	70	.037

a. Predictors: (Constant), whatprocess-fielding

b. Predictors: (Constant), whatprocess-fielding, whatprocess-training

c. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS

d. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P

e. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P, co

f. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P, com shrink-business

g. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P, co shrink-business, component-CASE

h. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P, co shrink-business, component-CASE, shrink-utilities

ANOVA[i]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.083	1	12.083	13.563	.000[a]
	Residual	68.600	77	.891		
	Total	80.684	78			
2	Regression	17.783	2	8.892	10.743	.000[b]
	Residual	62.900	76	.828		
	Total	80.684	78			
3	Regression	22.509	3	7.503	9.673	.000[c]
	Residual	58.174	75	.776		
	Total	80.684	78			
4	Regression	25.964	4	6.491	8.778	.000[d]
	Residual	54.719	74	.739		
	Total	80.684	78			
5	Regression	28.962	5	5.792	8.175	.000[e]
	Residual	51.722	73	.709		
	Total	80.684	78			
6	Regression	32.081	6	5.347	7.921	.000[f]
	Residual	48.602	72	.675		
	Total	80.684	78			
7	Regression	37.068	7	5.295	8.620	.000[g]
	Residual	43.616	71	.614		
	Total	80.684	78			
8	Regression	39.721	8	4.965	8.485	.000[h]
	Residual	40.962	70	.585		
	Total	80.684	78			

a. Predictors: (Constant), whatprocess-fielding

b. Predictors: (Constant), whatprocess-fielding, whatprocess-training

c. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS

d. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P

e. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P, component-domain

f. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P, component-domain, shrink-business

g. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P, component-domain, shrink-business, component-CASE

h. Predictors: (Constant), whatprocess-fielding, whatprocess-training, SYSTEMS, BOTH P&P, component-domain, shrink-business, component-CASE, shrink-utilities

i. Dependent Variable: consequence_intellectual_capital

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.221	.114		36.873	.000
	whatprocess-fielding	-1.130	.307	-.387	-3.683	.000
2	(Constant)	4.138	.115		36.063	.000
	whatprocess-fielding	-1.339	.306	-.459	-4.373	.000
	whatprocess-training	.804	.306	.275	2.624	.010
3	(Constant)	4.359	.143		30.525	.000
	whatprocess-fielding	-1.370	.297	-.469	-4.616	.000
	whatprocess-training	.773	.297	.265	2.606	.011
	SYSTEMS	-.495	.201	-.243	-2.468	.016
4	(Constant)	4.892	.283		17.285	.000
	whatprocess-fielding	-1.294	.292	-.443	-4.434	.000
	whatprocess-training	.849	.292	.291	2.909	.005
	SYSTEMS	-.479	.196	-.235	-2.446	.017
	BOTH P&P	-.641	.297	-.211	-2.161	.034
5	(Constant)	4.825	.279		17.298	.000
	whatprocess-fielding	-1.229	.287	-.421	-4.275	.000
	whatprocess-training	.798	.287	.273	2.784	.007
	SYSTEMS	-.515	.193	-.252	-2.673	.009
	BOTH P&P	-.608	.291	-.200	-2.091	.040
	component-domain	.811	.394	.195	2.057	.043
6	(Constant)	4.681	.280		16.698	.000
	whatprocess-fielding	-1.348	.286	-.462	-4.714	.000
	whatprocess-training	.846	.281	.290	3.015	.004
	SYSTEMS	-.480	.189	-.235	-2.542	.013
	BOTH P&P	-.544	.286	-.179	-1.904	.061
	component-domain	.872	.386	.210	2.260	.027
	shrink-business	.618	.287	.203	2.150	.035
7	(Constant)	4.718	.268		17.621	.000
	whatprocess-fielding	-1.269	.274	-.435	-4.626	.000
	whatprocess-training	.799	.268	.274	2.978	.004
	SYSTEMS	-.328	.188	-.161	-1.746	.085
	BOTH P&P	-.638	.274	-.210	-2.324	.023
	component-domain	.829	.368	.200	2.250	.028
	shrink-business	.884	.290	.291	3.053	.003
	component-CASE	-1.465	.514	-.277	-2.849	.006
8	(Constant)	4.826	.266		18.129	.000
	whatprocess-fielding	-1.299	.268	-.445	-4.845	.000
	whatprocess-training	.912	.267	.313	3.414	.001
	SYSTEMS	-.323	.183	-.158	-1.762	.082
	BOTH P&P	-.753	.273	-.248	-2.755	.007
	component-domain	1.040	.373	.251	2.788	.007
	shrink-business	.867	.283	.285	3.067	.003
	component-CASE	-1.480	.502	-.280	-2.949	.004
	shrink-utilities	-1.265	.594	-.197	-2.130	.037

a. Dependent Variable: consequence_intellectual_capital

Regression

Warnings

For models with dependent variable consequence_learning_curve, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	enterprise-OES	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_learning_curve

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.238[a]	.057	.045	1.1151	.057	4.642	1	77	.034

a. Predictors: (Constant), enterprise-OES

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.772	1	5.772	4.642	.034[a]
	Residual	95.747	77	1.243		
	Total	101.519	78			

a. Predictors: (Constant), enterprise-OES

b. Dependent Variable: consequence_learning_curve

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.221	.127		33.214	.000
	enterprise-OES	-1.721	.799	-.238	-2.155	.034

a. Dependent Variable: consequence_learning_curve

Regression

Warnings

For models with dependent variable consequence_quality, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatproducts-COTS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-reengineering	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_quality

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.305[a]	.093	.081	1.4209	.093	7.917	1	77	.006
2	.393[b]	.155	.132	1.3810	.061	5.510	1	76	.022

a. Predictors: (Constant), whatproducts-COTS

b. Predictors: (Constant), whatproducts-COTS, whatprocess-reengineering

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.984	1	15.984	7.917	.006[a]
	Residual	155.459	77	2.019		
	Total	171.443	78			
2	Regression	26.492	2	13.246	6.945	.002[b]
	Residual	144.951	76	1.907		
	Total	171.443	78			

a. Predictors: (Constant), whatproducts-COTS

b. Predictors: (Constant), whatproducts-COTS, whatprocess-reengineering

c. Dependent Variable: consequence_quality

Coefficients[a]

Model		Unstandardized Coefficients: B	Std. Error	Standardized Coefficients: Beta	t	Sig.
1	(Constant)	4.547	.178		25.600	.000
	whatproducts-COTS	-1.147	.408	-.305	-2.814	.006
2	(Constant)	4.397	.184		23.881	.000
	whatproducts-COTS	-1.253	.399	-.334	-3.142	.002
	whatprocess-reengineering	.961	.410	.249	2.347	.022

a. Dependent Variable: consequence_quality

Regression

Warnings

For models with dependent variable consequence_response_customer, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-SWEngSuppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_response_customer

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.290[a]	.084	.073	1.2978	.084	7.186	1	78	.009

a. Predictors: (Constant), whatprocess-SWEngSuppt

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.104	1	12.104	7.186	.009[a]
	Residual	131.383	78	1.684		
	Total	143.488	79			

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Dependent Variable: consequence_response_customer

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.407	.177		24.955	.000
	whatprocess-SWEngSuppt	-.830	.310	-.290	-2.681	.009

a. Dependent Variable: consequence_response_customer

Regression

Warnings

For models with dependent variable consequence_response_org_obj, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-SWEngSuppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_response_org_obj

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.308[a]	.095	.083	1.4763	.095	8.283	1	79	.005

a. Predictors: (Constant), whatprocess-SWEngSuppt

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.052	1	18.052	8.283	.005[a]
	Residual	172.171	79	2.179		
	Total	190.222	80			

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Dependent Variable: consequence_response_org_obj

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.473	.199		22.469	.000
	whatprocess-SWEngSuppt	-1.011	.351	-.308	-2.878	.005

a. Dependent Variable: consequence_response_org_obj

Regression

Warnings

For models with dependent variable consequence_rework, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatproducts-COTS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	COMPONENT	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_rework

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.322[a]	.104	.092	1.2538	.104	8.821	1	76	.004
2	.388[b]	.151	.128	1.2288	.047	4.124	1	75	.046

a. Predictors: (Constant), whatproducts-COTS

b. Predictors: (Constant), whatproducts-COTS, COMPONENT

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.867	1	13.867	8.821	.004[a]
	Residual	119.479	76	1.572		
	Total	133.346	77			
2	Regression	20.094	2	10.047	6.654	.002[b]
	Residual	113.252	75	1.510		
	Total	133.346	77			

a. Predictors: (Constant), whatproducts-COTS

b. Predictors: (Constant), whatproducts-COTS, COMPONENT

c. Dependent Variable: consequence_rework

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.063	.158		25.723	.000
	whatproducts-COTS	1.070	.360	.322	2.970	.004
2	(Constant)	3.850	.187		20.586	.000
	whatproducts-COTS	1.161	.356	.350	3.262	.002
	COMPONENT	.610	.301	.218	2.031	.046

a. Dependent Variable: consequence_rework

Regression

Warnings

For models with dependent variable consequence_risks, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	ENTERPRISE	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	SYSTEMS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	whatprocess-CM	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_risks

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.273[a]	.075	.063	1.5101	.075	6.279	1	78	.014
2	.350[b]	.123	.100	1.4796	.048	4.243	1	77	.043
3	.424[c]	.180	.147	1.4403	.057	5.263	1	76	.025

a. Predictors: (Constant), ENTERPRISE

b. Predictors: (Constant), ENTERPRISE, SYSTEMS

c. Predictors: (Constant), ENTERPRISE, SYSTEMS, whatprocess-CM

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14.318	1	14.318	6.279	.014[a]
	Residual	177.869	78	2.280		
	Total	192.188	79			
2	Regression	23.608	2	11.804	5.392	.006[b]
	Residual	168.580	77	2.189		
	Total	192.188	79			
3	Regression	34.527	3	11.509	5.548	.002[c]
	Residual	157.661	76	2.074		
	Total	192.188	79			

a. Predictors: (Constant), ENTERPRISE

b. Predictors: (Constant), ENTERPRISE, SYSTEMS

c. Predictors: (Constant), ENTERPRISE, SYSTEMS, whatprocess-CM

d. Dependent Variable: consequence_risks

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.473	.204		21.966	.000
	ENTERPRISE	-.913	.364	-.273	-2.506	.014
2	(Constant)	4.776	.248		19.269	.000
	ENTERPRISE	-.966	.358	-.289	-2.699	.009
	SYSTEMS	-.694	.337	-.220	-2.060	.043
3	(Constant)	5.006	.261		19.159	.000
	ENTERPRISE	-.885	.350	-.265	-2.528	.014
	SYSTEMS	-.789	.331	-.251	-2.387	.019
	whatprocess-CM	-.865	.377	-.242	-2.294	.025

a. Dependent Variable: consequence_risks

Regression

Warnings

For models with dependent variable consequence_sched_flex, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	enterprist-acctng	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_sched_flex

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.252[a]	.063	.051	1.4067	.063	5.283	1	78	.024

a. Predictors: (Constant), enterprist-acctng

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.453	1	10.453	5.283	.024[a]
	Residual	154.347	78	1.979		
	Total	164.800	79			

a. Predictors: (Constant), enterprist-acctng

b. Dependent Variable: consequence_sched_flex

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.107	.162		25.282	.000
	enterprist-acctng	1.493	.650	.252	2.298	.024

a. Dependent Variable: consequence_sched_flex

Regression

Warnings

For models with dependent variable consequence_schedule, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

a. Dependent Variable: consequence_schedule

Regression

Warnings

For models with dependent variable consequence_turf_war, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed [a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-SWEng Suppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-appsuppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	whatprocess-toolsuppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	whatproducts-COTS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	enterprise-manufact	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	systems-device	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_turf_war

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.281[a]	.079	.067	1.1534	.079	6.423	1	75	.013
2	.519[b]	.270	.250	1.0339	.191	19.331	1	74	.000
3	.572[c]	.327	.300	.9989	.058	6.274	1	73	.014
4	.613[d]	.376	.342	.9687	.049	5.621	1	72	.020
5	.645[e]	.415	.374	.9443	.039	4.771	1	71	.032
6	.669[f]	.447	.400	.9246	.032	4.059	1	70	.048

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt

c. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt, whatprocess-toolsu

d. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt, whatprocess-toolsu whatproducts-COTS

e. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt, whatprocess-toolsu whatproducts-COTS, enterprise-manufact

f. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt, whatprocess-toolsup whatproducts-COTS, enterprise-manufact, systems-device

ANOVA[g]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.544	1	8.544	6.423	.013[a]
	Residual	99.768	75	1.330		
	Total	108.312	76			
2	Regression	29.208	2	14.604	13.662	.000[b]
	Residual	79.104	74	1.069		
	Total	108.312	76			
3	Regression	35.469	3	11.823	11.848	.000[c]
	Residual	72.843	73	.998		
	Total	108.312	76			
4	Regression	40.743	4	10.186	10.854	.000[d]
	Residual	67.568	72	.938		
	Total	108.312	76			
5	Regression	44.998	5	9.000	10.092	.000[e]
	Residual	63.314	71	.892		
	Total	108.312	76			
6	Regression	48.468	6	8.078	9.449	.000[f]
	Residual	59.843	70	.855		
	Total	108.312	76			

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt

c. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt, whatprocess-toolsuppt

d. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt, whatprocess-toolsuppt, whatproducts-COTS

e. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt, whatprocess-toolsuppt, whatproducts-COTS, enterprise-manufact

f. Predictors: (Constant), whatprocess-SWEngSuppt, whatprocess-appsuppt, whatprocess-toolsuppt, whatproducts-COTS, enterprise-manufact, systems-device

g. Dependent Variable: consequence_turf_war

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.373	.162		27.074	.000
	whatprocess-SWEngSuppt	.704	.278	.281	2.534	.013
2	(Constant)	4.406	.145		30.391	.000
	whatprocess-SWEngSuppt	1.326	.286	.529	4.628	.000
	whatprocess-appsuppt	-1.702	.387	-.502	-4.397	.000
3	(Constant)	4.347	.142		30.607	.000
	whatprocess-SWEngSuppt	1.065	.296	.425	3.605	.001
	whatprocess-appsuppt	-1.919	.384	-.566	-4.998	.000
	whatprocess-toolsuppt	.805	.321	.281	2.505	.014
4	(Constant)	4.231	.146		28.938	.000
	whatprocess-SWEngSuppt	1.079	.287	.430	3.762	.000
	whatprocess-appsuppt	-2.063	.377	-.609	-5.470	.000
	whatprocess-toolsuppt	.813	.312	.284	2.608	.011
	whatproducts-COTS	.671	.283	.224	2.371	.020
5	(Constant)	4.228	.143		29.669	.000
	whatprocess-SWEngSuppt	1.089	.280	.434	3.896	.000
	whatprocess-appsuppt	-2.246	.377	-.663	-5.956	.000
	whatprocess-toolsuppt	.738	.306	.258	2.413	.018
	whatproducts-COTS	.738	.278	.247	2.658	.010
	enterprise-manufact	2.191	1.003	.209	2.184	.032
6	(Constant)	4.166	.143		29.145	.000
	whatprocess-SWEngSuppt	1.072	.274	.427	3.914	.000
	whatprocess-appsuppt	-2.573	.403	-.759	-6.380	.000
	whatprocess-toolsuppt	.843	.304	.295	2.775	.007
	whatproducts-COTS	.867	.279	.289	3.103	.003
	enterprise-manufact	2.492	.994	.238	2.508	.014
	systems-device	.966	.479	.201	2.015	.048

a. Dependent Variable: consequence_turf_war

Regression

Warnings

For models with dependent variable consequence_visibility, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-reengineering	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatproducts-none	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	whatproducts-custom	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: consequence_visibility

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.315[a]	.099	.088	1.2679	.099	8.585	1	78	.004
2	.389[b]	.151	.129	1.2385	.052	4.746	1	77	.032
3	.442[c]	.196	.164	1.2137	.044	4.174	1	76	.045

a. Predictors: (Constant), whatprocess-reengineering

b. Predictors: (Constant), whatprocess-reengineering, whatproducts-none

c. Predictors: (Constant), whatprocess-reengineering, whatproducts-none, whatproducts-custom

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.800	1	13.800	8.585	.004[a]
	Residual	125.387	78	1.608		
	Total	139.188	79			
2	Regression	21.080	2	10.540	6.872	.002[b]
	Residual	118.107	77	1.534		
	Total	139.188	79			
3	Regression	27.229	3	9.076	6.161	.001[c]
	Residual	111.958	76	1.473		
	Total	139.188	79			

a. Predictors: (Constant), whatprocess-reengineering

b. Predictors: (Constant), whatprocess-reengineering, whatproducts-none

c. Predictors: (Constant), whatprocess-reengineering, whatproducts-none, whatproducts-custom

d. Dependent Variable: consequence_visibility

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.121	.156		19.999	.000
	whatprocess-reengineering	1.093	.373	.315	2.930	.004
2	(Constant)	3.063	.155		19.782	.000
	whatprocess-reengineering	1.152	.365	.332	3.152	.002
	whatproducts-none	1.937	.889	.229	2.179	.032
3	(Constant)	2.623	.263		9.959	.000
	whatprocess-reengineering	1.100	.359	.317	3.064	.003
	whatproducts-none	2.377	.898	.281	2.648	.010
	whatproducts-custom	.625	.306	.217	2.043	.045

a. Dependent Variable: consequence_visibility

Regression

Warnings

For models with dependent variable goal_rslt_add_people_capacity, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

a. Dependent Variable: goal_rslt_add_people_capacity

Regression

Warnings

For models with dependent variable goal_rslt_add_people_short, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatproducts-common-cust	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	enterprist-acctng	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_add_people_short

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.371[a]	.138	.122	.6990	.138	8.930	1	56	.004
2	.477[b]	.227	.199	.6677	.090	6.379	1	55	.014

a. Predictors: (Constant), whatproducts-common-cust

b. Predictors: (Constant), whatproducts-common-cust, enterprist-acctng

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.363	1	4.363	8.930	.004[a]
	Residual	27.361	56	.489		
	Total	31.724	57			
2	Regression	7.207	2	3.603	8.083	.001[b]
	Residual	24.517	55	.446		
	Total	31.724	57			

a. Predictors: (Constant), whatproducts-common-cust

b. Predictors: (Constant), whatproducts-common-cust, enterprist-acctng

c. Dependent Variable: goal_rslt_add_people_short

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.093	.107		29.016	.000
	whatproducts-common-cust	-.626	.210	-.371	-2.988	.004
2	(Constant)	3.032	.105		28.976	.000
	whatproducts-common-cust	-.624	.200	-.369	-3.115	.003
	enterprist-acctng	.874	.346	.299	2.526	.014

a. Dependent Variable: goal_rslt_add_people_short

Regression

Warnings

For models with dependent variable goal_rslt_cash, the following variables are constants or have missing correlations: enterprise-manufact, shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	systems-device	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	enterprise-web	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_cash

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.603[a]	.363	.350	.4953	.363	27.396	1	48	.000
2	.653[b]	.426	.402	.4751	.063	5.171	1	47	.028

a. Predictors: (Constant), systems-device

b. Predictors: (Constant), systems-device, enterprise-web

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.722	1	6.722	27.396	.000[a]
	Residual	11.778	48	.245		
	Total	18.500	49			
2	Regression	7.890	2	3.945	17.474	.000[b]
	Residual	10.610	47	.226		
	Total	18.500	49			

a. Predictors: (Constant), systems-device

b. Predictors: (Constant), systems-device, enterprise-web

c. Dependent Variable: goal_rslt_cash

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.822	.074		38.220	.000
	systems-device	-1.222	.234	-.603	-5.234	.000
2	(Constant)	2.879	.075		38.325	.000
	systems-device	-1.023	.241	-.504	-4.253	.000
	enterprise-web	-.427	.188	-.270	-2.274	.028

a. Dependent Variable: goal_rslt_cash

Regression

Warnings

For models with dependent variable goal_rslt_control, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-reengineering	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-requirements	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_control

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.305[a]	.093	.079	1.0050	.093	6.453	1	63	.014
2	.425[b]	.181	.154	.9628	.088	6.641	1	62	.012

a. Predictors: (Constant), whatprocess-reengineering

b. Predictors: (Constant), whatprocess-requirements

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.518	1	6.518	6.453	.014[a]
	Residual	63.636	63	1.010		
	Total	70.154	64			
2	Regression	12.675	2	6.337	6.836	.002[b]
	Residual	57.479	62	.927		
	Total	70.154	64			

a. Predictors: (Constant), whatprocess-reengineering

b. Predictors: (Constant), whatprocess-reengineering, whatprocess-requirements

c. Dependent Variable: goal_rslt_control

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.373	.141		16.859	.000
	whatprocess-reengineering	.770	.303	.305	2.540	.014
2	(Constant)	2.547	.151		16.880	.000
	whatprocess-reengineering	.987	.302	.391	3.264	.002
	whatprocess-requirements	-.685	.266	-.308	-2.577	.012

a. Dependent Variable: goal_rslt_control

Regression

Warnings

For models with dependent variable goal_rslt_expertise, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	SYSTEMS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	shrink-internet	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	whatprocess-reengineering	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_expertise

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.269[a]	.072	.059	.9529	.072	5.309	1	68	.024
2	.363[b]	.132	.106	.9289	.059	4.567	1	67	.036
3	.442[c]	.195	.159	.9009	.064	5.219	1	66	.026

a. Predictors: (Constant), SYSTEMS

b. Predictors: (Constant), SYSTEMS, shrink-internet

c. Predictors: (Constant), SYSTEMS, shrink-internet, whatprocess-reengineering

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.821	1	4.821	5.309	.024[a]
	Residual	61.750	68	.908		
	Total	66.571	69			
2	Regression	8.762	2	4.381	5.078	.009[b]
	Residual	57.809	67	.863		
	Total	66.571	69			
3	Regression	12.999	3	4.333	5.338	.002[c]
	Residual	53.572	66	.812		
	Total	66.571	69			

a. Predictors: (Constant), SYSTEMS

b. Predictors: (Constant), SYSTEMS, shrink-internet

c. Predictors: (Constant), SYSTEMS, shrink-internet, whatprocess-reengineering

d. Dependent Variable: goal_rslt_expertise

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.929	.147		19.917	.000
	SYSTEMS	.536	.232	.269	2.304	.024
2	(Constant)	2.973	.145		20.528	.000
	SYSTEMS	.591	.228	.297	2.591	.012
	shrink-internet	-.927	.434	-.245	-2.137	.036
3	(Constant)	2.864	.148		19.311	.000
	SYSTEMS	.592	.221	.297	2.676	.009
	shrink-internet	-1.203	.438	-.318	-2.748	.008
	whatprocess-reengineering	.640	.280	.263	2.285	.026

a. Dependent Variable: goal_rslt_expertise

Regression

Warnings

For models with dependent variable goal_rslt_non_core, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	systems-device	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatproducts-COTS	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_non_core

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.262[a]	.069	.053	.7536	.069	4.436	1	60	.039
2	.364[b]	.132	.103	.7337	.063	4.309	1	59	.042

a. Predictors: (Constant), systems-device

b. Predictors: (Constant), systems-device, whatproducts-COTS

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.520	1	2.520	4.436	.039[a]
	Residual	34.077	60	.568		
	Total	36.597	61			
2	Regression	4.839	2	2.420	4.495	.015[b]
	Residual	31.758	59	.538		
	Total	36.597	61			

a. Predictors: (Constant), systems-device

b. Predictors: (Constant), systems-device, whatproducts-COTS

c. Dependent Variable: goal_rslt_non_core

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.140	.100		31.460	.000
	systems-device	-.740	.352	-.262	-2.106	.039
2	(Constant)	3.250	.111		29.384	.000
	systems-device	-.850	.346	-.301	-2.455	.017
	whatproducts-COTS	-.481	.232	-.255	-2.076	.042

a. Dependent Variable: goal_rslt_non_core

Regression

Warnings

For models with dependent variable goal_rslt_quality, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	systems-device	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_quality

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.329[a]	.109	.094	1.0385	.109	7.547	1	62	.008

a. Predictors: (Constant), systems-device

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.139	1	8.139	7.547	.008[a]
	Residual	66.861	62	1.078		
	Total	75.000	63			

a. Predictors: (Constant), systems-device

b. Dependent Variable: goal_rslt_quality

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.729	.135		20.184	.000
	systems-device	-1.329	.484	-.329	-2.747	.008

a. Dependent Variable: goal_rslt_quality

Regression

Warnings

For models with dependent variable goal_rslt_reduce_cost_economies, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-fielding	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_reduce_cost_economies

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.253[a]	.064	.050	.8821	.064	4.508	1	66	.037

a. Predictors: (Constant), whatprocess-fielding

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.508	1	3.508	4.508	.037[a]
	Residual	51.359	66	.778		
	Total	54.868	67			

a. Predictors: (Constant), whatprocess-fielding

b. Dependent Variable: goal_rslt_reduce_cost_economies

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.655	.119		22.317	.000
	whatprocess-fielding	-.578	.272	-.253	-2.123	.037

a. Dependent Variable: goal_rslt_reduce_cost_economies

Regression

Warnings

For models with dependent variable goal_rslt_reduce_sched_parallel, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-SWEngSuppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	systems-avionics	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_reduce_sched_parallel

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.301[a]	.091	.077	.8288	.091	6.788	1	68	.011
2	.409[b]	.167	.142	.7991	.077	6.155	1	67	.016

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Predictors: (Constant), whatprocess-SWEngSuppt, systems-avionics

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.663	1	4.663	6.788	.011[a]
	Residual	46.709	68	.687		
	Total	51.371	69			
2	Regression	8.593	2	4.296	6.729	.002[b]
	Residual	42.778	67	.638		
	Total	51.371	69			

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Predictors: (Constant), whatprocess-SWEngSuppt, systems-avionics

c. Dependent Variable: goal_rslt_reduce_sched_parallel

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.723	.121		22.528	.000
	whatprocess-SW EngSuppt	-.549	.211	-.301	-2.605	.011
2	(Constant)	2.701	.117		23.107	.000
	whatprocess-SW EngSuppt	-.664	.208	-.364	-3.184	.002
	systems-avionics	1.047	.422	.284	2.481	.016

a. Dependent Variable: goal_rslt_reduce_sched_parallel

Regression

Warnings

For models with dependent variable goal_rslt_reduce_sched_vendor, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-requirements	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_reduce_sched_vendor

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.261[a]	.068	.055	.9952	.068	5.039	1	69	.028

a. Predictors: (Constant), whatprocess-requirements

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.990	1	4.990	5.039	.028[a]
	Residual	68.334	69	.990		
	Total	73.324	70			

a. Predictors: (Constant), whatprocess-requirements

b. Dependent Variable: goal_rslt_reduce_sched_vendor

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.245	.142		15.791	.00[illegible]
	whatprocess-requirements	.573	.255	.261	2.245	.02[illegible]

a. Dependent Variable: goal_rslt_reduce_sched_vendor

Regression

Warnings

For models with dependent variable goal_rslt_response_cust, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-SWEng Suppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	systems-device	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	enterprise-OES	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	systems-avionics	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_response_cust

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.362[a]	.131	.118	.9953	.131	9.676	1	64	.003
2	.464[b]	.215	.190	.9536	.084	6.716	1	63	.012
3	.518[c]	.268	.233	.9282	.053	4.503	1	62	.038
4	.560[d]	.313	.268	.9064	.045	4.016	1	61	.050

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Predictors: (Constant), whatprocess-SWEngSuppt, systems-device

c. Predictors: (Constant), whatprocess-SWEngSuppt, systems-device, enterprise-OES

d. Predictors: (Constant), whatprocess-SWEngSuppt, systems-device, enterprise-OES, systems-

ANOVA[e]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.585	1	9.585	9.676	.003[a]
	Residual	63.399	64	.991		
	Total	72.985	65			
2	Regression	15.693	2	7.847	8.628	.000[b]
	Residual	57.292	63	.909		
	Total	72.985	65			
3	Regression	19.572	3	6.524	7.573	.000[c]
	Residual	53.413	62	.861		
	Total	72.985	65			
4	Regression	22.872	4	5.718	6.960	.000[d]
	Residual	50.113	61	.822		
	Total	72.985	65			

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Predictors: (Constant), whatprocess-SWEngSuppt, systems-device

c. Predictors: (Constant), whatprocess-SWEngSuppt, systems-device, enterprise-OES

d. Predictors: (Constant), whatprocess-SWEngSuppt, systems-device, enterprise-OES, systems-avionics

e. Dependent Variable: goal_rslt_response_cust

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.930	.152		19.306	.000
	whatprocess-SW EngSuppt	-.800	.257	-.362	-3.111	.003
2	(Constant)	2.984	.147		20.313	.000
	whatprocess-SW EngSuppt	-.702	.249	-.318	-2.818	.006
	systems-device	-1.163	.449	-.293	-2.592	.012
3	(Constant)	2.949	.144		20.481	.000
	whatprocess-SW EngSuppt	-.736	.243	-.333	-3.026	.004
	systems-device	-1.107	.438	-.279	-2.531	.014
	enterprise-OES	1.419	.669	.231	2.122	.038
4	(Constant)	2.920	.141		20.658	.000
	whatprocess-SW EngSuppt	-.849	.244	-.385	-3.479	.001
	systems-device	-1.010	.430	-.254	-2.349	.022
	enterprise-OES	1.505	.654	.245	2.299	.025
	systems-avionics	.967	.483	.219	2.004	.050

a. Dependent Variable: goal_rslt_response_cust

Regression

Warnings

For models with dependent variable goal_rslt_response_org, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	systems-device	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-SWEng Suppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	whatprocess-coding	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_response_org

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.353[a]	.125	.112	.9846	.125	9.545	1	67	.003
2	.418[b]	.175	.150	.9632	.050	4.001	1	66	.050
3	.488[c]	.238	.203	.9325	.063	5.418	1	65	.023

a. Predictors: (Constant), systems-device

b. Predictors: (Constant), systems-device, whatprocess-SWEngSuppt

c. Predictors: (Constant), systems-device, whatprocess-SWEngSuppt, whatprocess-coding

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.253	1	9.253	9.545	.003[a]
	Residual	64.950	67	.969		
	Total	74.203	68			
2	Regression	12.965	2	6.483	6.987	.002[b]
	Residual	61.237	66	.928		
	Total	74.203	68			
3	Regression	17.677	3	5.892	6.776	.000[c]
	Residual	56.526	65	.870		
	Total	74.203	68			

a. Predictors: (Constant), systems-device

b. Predictors: (Constant), systems-device, whatprocess-SWEngSuppt

c. Predictors: (Constant), systems-device, whatprocess-SWEngSuppt, whatprocess-coding

d. Dependent Variable: goal_rslt_response_org

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.813	.123		22.852	.000
	systems-device	-1.413	.457	-.353	-3.089	.003
2	(Constant)	2.968	.143		20.702	.000
	systems-device	-1.269	.453	-.317	-2.802	.007
	whatprocess-SWEngSuppt	-.498	.249	-.227	-2.000	.050
3	(Constant)	2.310	.315		7.329	.000
	systems-device	-1.178	.440	-.294	-2.675	.009
	whatprocess-SWEngSuppt	-.610	.246	-.277	-2.479	.016
	whatprocess-coding	.792	.340	.257	2.328	.023

a. Dependent Variable: goal_rslt_response_org

Regression

Warnings

For models with dependent variable goal_rslt_risk_share, the following variables are constants or have missing correlations: shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-SWEng Suppt	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_risk_share

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.273[a]	.075	.059	.9251	.075	4.687	1	58	.035

a. Predictors: (Constant), whatprocess-SWEngSuppt

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.011	1	4.011	4.687	.035[a]
	Residual	49.639	58	.856		
	Total	53.650	59			

a. Predictors: (Constant), whatprocess-SWEngSuppt

b. Dependent Variable: goal_rslt_risk_share

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.861	.154		18.556	.000
	whatprocess-SWEngSuppt	-.528	.244	-.273	-2.165	.035

a. Dependent Variable: goal_rslt_risk_share

Regression

Warnings

For models with dependent variable goal_rslt_staff_stable, the following variables are constants or have missing correlations: enterprise-manufact, shrink-entertainment, whatprocess-none. They will be deleted from the analysis.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	whatprocess-maintenance	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	whatprocess-CM	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	whatprocess-reengineering	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	whatproducts-none	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: goal_rslt_staff_stable

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.280[a]	.079	.063	.6638	.079	4.943	1	58	.030
2	.477[b]	.228	.201	.6129	.149	11.027	1	57	.002
3	.533[c]	.284	.245	.5955	.056	4.374	1	56	.041
4	.580[d]	.336	.288	.5785	.052	4.341	1	55	.042

a. Predictors: (Constant), whatprocess-maintenance

b. Predictors: (Constant), whatprocess-maintenance, whatprocess-CM

c. Predictors: (Constant), whatprocess-maintenance, whatprocess-CM, whatprocess-reengineerin

d. Predictors: (Constant), whatprocess-maintenance, whatprocess-CM, whatprocess-reengineerin whatproducts-none

ANOVA[e]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.178	1	2.178	4.943	.030[a]
	Residual	25.556	58	.441		
	Total	27.733	59			
2	Regression	6.320	2	3.160	8.412	.001[b]
	Residual	21.413	57	.376		
	Total	27.733	59			
3	Regression	7.871	3	2.624	7.398	.000[c]
	Residual	19.862	56	.355		
	Total	27.733	59			
4	Regression	9.325	4	2.331	6.965	.000[d]
	Residual	18.409	55	.335		
	Total	27.733	59			

a. Predictors: (Constant), whatprocess-maintenance

b. Predictors: (Constant), whatprocess-maintenance, whatprocess-CM

c. Predictors: (Constant), whatprocess-maintenance, whatprocess-CM, whatprocess-reengineering

d. Predictors: (Constant), whatprocess-maintenance, whatprocess-CM, whatprocess-reengineering, whatproducts-none

e. Dependent Variable: goal_rslt_staff_stable

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.778	.111		25.108	.000
	whatprocess-maintenance	.389	.175	.280	2.223	.030
2	(Constant)	2.851	.105		27.280	.000
	whatprocess-maintenance	.673	.183	.485	3.682	.001
	whatprocess-CM	-.660	.199	-.437	-3.321	.002
3	(Constant)	2.813	.103		27.259	.000
	whatprocess-maintenance	.657	.178	.474	3.698	.000
	whatprocess-CM	-.770	.200	-.510	-3.848	.000
	whatprocess-reengineering	.455	.218	.249	2.091	.041
4	(Constant)	2.776	.102		27.275	.000
	whatprocess-maintenance	.685	.173	.493	3.953	.000
	whatprocess-CM	-.759	.195	-.503	-3.903	.000
	whatprocess-reengineering	.469	.211	.257	2.217	.031
	whatproducts-none	1.224	.587	.230	2.084	.042

a. Dependent Variable: goal_rslt_staff_stable

Appendix C: Outsourcing Survey Document

Software Outsourcing — Study Objectives

We are researchers in the Arizona State University's Computer Science and Engineering Department who are investigating software development outsourcing. According to published accounts, software development outsourcing has become commonplace and often meets organizational goals. Unfortunately, nearly 30% of outsourcing relationships end poorly (anything from general dissatisfaction to legal action).

With your assistance, we hope to identify software outsourcing strategies, motivations, benefits, drawbacks, and relevant project situation variables. This information will help us to discern why outsourcing efforts succeed or fail to meet goals and which strategies are most appropriate for specific projects and goals. Using this knowledge, we will produce a process simulation tool which will allow researchers and project managers to more closely study the inter-organizational relations within a planned outsourcing relationship and their impact on the overall software development process. A second tool, for decision support, will then be constructed to aid software development project managers and consultants in making software outsourcing strategy decisions for specific projects.

> Definition
>
> **Software development outsourcing**: hiring of vendors to perform software development activities or develop a portion of an overall software product. It does not include the hiring of temporary employees.

Who can help?

You can help by completing this brief survey if, within the last 2 years, you have participated in a software development project where any portion of the product development or effort has been contracted to an outside vendor (regardless of which side of the relationship you worked on). This survey includes questions about your background, your most recent software outsourcing project, and general outsourcing experience over the past five years. The questionnaire is designed to take less than 15 minutes to complete.

What do I get for helping?

If you choose to participate, your answers will be held in the **strictest** confidence. Only our research team will see your individual answers. Our reports will consist of summaries of data from all respondents. When completed (planned for late spring 1999), these summary reports will be available to survey participants via our outsourcing website (http://www.eas.asu.edu/~outsrc/). **If you provide the optional contact information, you will be notified when survey results are posted and will be provided with free copies of the decision support tools when they become available.**

Feel free to contact us with any questions you might have regarding our research. Thank you for your assistance.

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I. Instructions

1. For the purposes of this study, we define software development outsourcing as the hiring of vendors to perform software development activities or to develop a portion of a software product. It does not include the hiring of temporary employees.
2. Please answer every question. Some questions may look like others, but each one is different.
3. There are no right or wrong answers. Please provide a realistic assessment of each item based on your experiences. The focus of the survey is on your experience, not on what you wish were true or what may be true in the future.
4. For questions pertaining to this survey please contact Brian Hermann via e-mail at brian.hermann@asu.edu.
5. Please return this survey to:

Brian G. Hermann
Computer Science and Engineering Department
College of Engineering and Applied Sciences
Arizona State University
Box 875406
Tempe, AZ 85287-5406, U.S.A.

6. Please remove this page for your information and continue with the survey.

Confidentiality

Your responses to this survey are confidential. As summarized below, no organization or individual respondent will be identified by name in any analyses or report without your written permission.

PUBLIC LAW 93-759, entitled the Privacy Act of 1974 requires that all individuals be informed of the purposes and uses to be made of the information which is solicited. The following is furnished to explain why the information is requested and the general uses to which the information may be put.

Purpose: This study strives to examine software outsourcing strategies, motivations, benefits, drawbacks, and relevant project situation variables. The survey results will be used both to better understand software outsourcing, as well as to develop a software outsourcing process simulation tool.

Uses: Survey data are used for research purposes only. Individual responses are confidential. Only summarized data will be reported to you, if you so request, and academic audiences.

Effects of Non-Disclosure: Participation in the study is voluntary. No penalty will be imposed for failure to respond to any particular question.

II. Background Information

1. **How many software development projects involving outsourcing have you participated in during the past five years? __________ Projects**

2. **Roughly, what portion of your organization's software development has been outsourced during the past five years? __________ %**

3. **The final result of this research will be a suite of software tools to help practitioners in various roles evaluate software outsourcing strategies and better understand software outsourcing dynamics and constraints. Would these types of tools be helpful to you?**

   ❑ Yes ❑ No

   Why or Why Not? ____

   ____

4. **In the future, would you like to be contacted to have the opportunity to provide inputs to other software outsourcing research questionnaires and to receive copies of the software outsourcing decision support and simulation tools?**

   ❑ Yes ❑ No

5. **Please provide your name and best method of contact (all results will be kept confidential)**

Name	
Electronic mail	
Telephone	( ) – extension
Standard Mail	

III. Most Recent Software Development Outsourcing Project Experience

Please answer the following questions for the *most recent* software outsourcing project that you worked on (within the last 2 years). If you have worked on multiple projects recently, please answer the questions utilizing the project about which you have the most knowledge.

6. **What type of software was developed in this project? Please check application area (domain) and/or project type.**

♦ **Systems software, e.g.:**
- ❑ Avionics
- ❑ Embedded controllers and firm-ware
- ❑ Communications systems
- ❑ Device drivers
- ❑ Other: ____________________

♦ **Shrink-wrap commercial/consumer software products, e.g.:**
- ❑ Entertainment
- ❑ Business productivity
- ❑ Utilities
- ❑ Internet
- ❑ Other: ____________________

♦ **Software component development, e.g.:**
- ❑ Domain frameworks
- ❑ CASE tools
- ❑ Class libraries
- ❑ Operating systems
- ❑ Development tools
- ❑ Other: ____________________

♦ **Enterprise software development and package customization, e.g.:**
- ❑ Accounting systems
- ❑ Manufacturing requirements planning
- ❑ Payroll systems
- ❑ Order Entry System
- ❑ Scripting and extensions development
- ❑ Interactive web-site development
- ❑ Other: ____________________

7. Which software development *process* components or activities were outsourced on this project? (Select all that apply)

- ❑ Requirements
- ❑ Design
- ❑ Testing
- ❑ Maintenance
- ❑ Reengineering
- ❑ Application support (for enterprise systems)
- ❑ Training (e.g., languages, processes)
- ❑ Specification
- ❑ Documentation
- ❑ Coding
- ❑ Fielding
- ❑ Configuration management
- ❑ Tools support (e.g., requirements database, version control tool)
- ❑ Software engineering support (e.g., code reviews, SEI reviews, quality reviews)
- ❑ None
- ❑ Other (please list) ____________________

____

How would you describe the process components you outsourced? ____________________________________

____

____

8. Which *product* components were outsourced during this software development?

- ❑ Custom (specialized)
- ❑ Common application (off the shelf)
- ❑ Common application (customized version of an available component)
- ❑ None
- ❑ Other (please list) ____

____

How would you describe the product components you outsourced? ____________________________________

____

____

9. With respect to in-house development, what project goals (motivations for outsourcing) were part of the decision to outsource software development for this project?

Please note there are two parts to this question:

a. Estimate the importance of each goal using the importance scale and the blanks to the left of each goal.

b. Estimate the degree to which these goals were realized by the selected outsourcing strategy -- circle the appropriate number on the scale to the right of each goal.

Importance Scale

Not Important		Somewhat Important		Very Important
1	2	3	4	5

Importance	Goals	Significantly Worse than Expectations		Exactly on Target		Significantly Better than Expectations
	Costs & Schedule					
______	a. Reduce project costs by taking advantage of outsourcing vendor's economies of scale	1	2	3	4	5
______	b. Reduce development schedule — a vendor can complete the job faster than our in-house team	1	2	3	4	5
______	c. Reduce development schedule — parallel activities from dividing the effort speeds up the overall schedule	1	2	3	4	5
______	d. Cash flow from sale of the outsourced product's distribution rights to the outsourcing vendor	1	2	3	4	5
	Personnel					
______	e. Acquire expertise not available within the internal organization (e.g. domain, language, tool, etc.)	1	2	3	4	5
______	f. Add more personnel to the project (necessary due to an insufficient in-house capacity)	1	2	3	4	5
______	g. Add more personnel to fill a short-term, part-time or transient need for effort (e.g., only for fielding at the end of the project)	1	2	3	4	5
______	h. Outsource 'non-core' activities	1	2	3	4	5
______	i. Control over outsourced project management process	1	2	3	4	5
______	j. Improved response to customer objectives	1	2	3	4	5
______	k. Improved response to organizational objectives and strategies	1	2	3	4	5
______	l. Keep in-house staffing levels more stable	1	2	3	4	5
	General					
______	m. Risk sharing or reduction of likelihood and/or consequence (e.g., technical, cost)	1	2	3	4	5
______	n. Product quality improvement	1	2	3	4	5
	Other (please list)					
______	o. ______________________	1	2	3	4	5
______	p. ______________________	1	2	3	4	5
______	q. ______________________	1	2	3	4	5

10. What were the consequences of outsourcing in this project in comparison to similar in-house efforts? (Put the appropriate number from the consequence scale in the blank next to each factor)

Decreased Dramatically	Decreased Significantly	Decreased Slightly	No Change	Increased Slightly	Increased Significantly	Increased Dramatically
1	2	3	4	5	6	7

____ a. Project costs

____ b. Development schedule (vendor outsourcing compared to in-house)

____ c. Intellectual capital (your organization's rights to the developed software product)

____ d. Scheduling flexibility (including ability to respond to immediate needs such as a late project productivity burst)

____ e. Administrative overhead

____ f. Control over outsourced project management process

____ g. In-house effort spent on 'non-core' activities

____ h. In-house personnel turnover

____ i. Project learning curve (time required to become productive on the project)

____ j. Development risks

____ k. Product quality

____ l. Rework

____ m. Visibility into software development process (ability to ascertain development progress, adherence to process standards, and product quality)

____ n. Control over final product

____ o. Costs associated with design or requirements changes

____ p. Cultural, location, and language problems

____ q. Turf wars (e.g. finger pointing between development groups -- either in-house or vendors)

____ r. Likelihood of a failed or cancelled project

____ s. Response to customer objectives

____ t. Response to organizational objectives and strategies

Other (please list any other outsourcing consequences not already shown -- include impact rating if appropriate)

____ u.

____ v.

____ w.

11. On this project who (or what project roles) drove outsourcing decision making? (Select all that apply)

Outsourcing Customer (organization which hires and outside vendor to develop software)

- ❑ Project manager
- ❑ Contract officer
- ❑ Technical lead
- ❑ Software developer
- ❑ Corporate management policy
- ❑ Corporate management (one-time decision)
- ❑ Management consultant working for an outsourcing customer
- ❑ Other (Please Explain) ______________

____

Outsourcing Vendor (organization which develops software for another organization)

- ❑ Project manager
- ❑ Contract officer
- ❑ Technical lead
- ❑ Software developer
- ❑ Other (Please Explain) ______________

____

12. What role(s) did you play in this software outsourcing relationship?(Select all that apply)

Outsourcing Customer (organization which hires and outside vendor to develop software)

- ❑ Project manager
- ❑ Contract officer
- ❑ Technical lead
- ❑ Software developer
- ❑ Management consultant working for an outsourcing customer
- ❑ Other (Please Explain) ______________

____

Outsourcing Vendor (organization which develops software for another organization)

- ❑ Project manager
- ❑ Contract officer
- ❑ Technical lead
- ❑ Software developer
- ❑ Other (Please Explain) ______________

____

IV. General Outsourcing Experience

Instructions - Consider outsourcing projects you've worked on in the last five years.

13. Based upon your experience, identify your level of agreement with the following assertions about software development outsourcing.

(Put the appropriate number from the scale in the blank next to each assertion)

Agreement Scale

Strongly Disagree		Neither Agree Nor Disagree		Strongly Agree
1	2	3	4	5

Project Assertions

____ ❑ Outsourcing portions of larger software development projects is more successful than outsourcing portions of smaller software development projects.

____ ❑ Larger outsourcing efforts are more successful than smaller outsourcing efforts.

____ ❑ Outsourcing development of software in some domains is more successful than outsourcing development of software in other domains.

____ ❑ Outsourcing development of software in a domain familiar to the **buyer** (in-house organization) is more successful than outsourcing development of software in an unfamiliar domain.

____ ❑ Outsourcing development of software in a domain familiar to the **vendor** is more successful than outsourcing development of software in a domain with which the vendor is unfamiliar.

____ ❑ Outsourcing development of software is more successful when more vendors are available in the project domain.

____ ❑ Outsourcing development of software is more successful when the software vendor has more experience with tools or languages.

____ ❑ Outsourcing development of software is more successful when the software vendor has reusable design or code components.

Buyer-Seller Relationship and Contract Assertions

____ ❑ Outsourcing projects with frequent reviews and inspections are more successful than outsourcing projects with less frequent reviews and inspections.

____ ❑ Outsourcing project success is closely related to payment strategies and incentives in the vendor contract (e.g., fixed-price contracts projects are more or less successful than cost-plus type contracts).

____ ❑ Outsourcing project success is closely tied to the form of communication between the buyer and vendor (forms of communication include formal letters, e-mail, telephone conversations, face-to-face meetings, etc.).

____ ❑ Outsourcing projects are more successful when the buyer has more visibility into the vendor's development process.

____ ❑ Outsourcing projects are more successful when the buyer and vendor are located nearby.

____ ❑ Outsourcing projects are more successful when the buyer and vendor are located far apart (such as "off-shore" arrangements) because time differences increase the collaborative work day length.

____ ❑ Outsourcing projects are more successful when the buyer and vendor have previously worked together successfully.

____ ❑ Outsourcing development of software is more successful when the software **vendor** has a higher process maturity (e.g. SEI CMM rating).

____ ❑ Outsourcing development of software is more successful when the **buyer** has a higher process maturity (e.g. SEI CMM rating).

____ ❑ Outsourcing development of software is more successful when the vendor has a successful track record.

(Question 13 Continued) Based upon your experience, identify your level of agreement with the following assertions about software development outsourcing.
(Put the appropriate number from the scale in the blank next to each assertion)

Agreement Scale

Strongly Disagree		Neither Agree Nor Disagree		Strongly Agree
1	2	3	4	5

Goal and Expectation Assertions

____ s. Outsourcing projects with more aggressive cost reduction goals are **less likely** to be successful than those with more modest cost reduction goals.

____ t. Outsourcing projects with more aggressive cost reduction goals are **more likely** to be successful than those with more modest cost reduction goals.

____ u. Outsourcing projects with more aggressive schedule duration reduction goals are **less likely** to be successful than those with more modest schedule duration reduction goals.

____ v. Outsourcing projects with more aggressive schedule duration reduction goals are **more likely** to be successful than those with more modest schedule duration reduction goals.

Product Assertions

____ w. Outsourcing development of software is more successful when the system is not complex.

____ x. Outsourcing development of software is more successful when the system can be easily divided into components (highly modular).

Other Assertions (please list)

____ y.

____ z.

____ aa.

14. Based on your experience, identify your level of agreement with each of the following assertions about which factors determine whether *product* component outsourcing will be successful.
(Put the appropriate number from the scale in the blank next to each assertion)

Agreement Scale

Strongly Disagree		Neither Agree Nor Disagree		Strongly Agree
1	2	3	4	5

_____ a. Outsourcing larger components is generally more successful than outsourcing smaller components.

_____ b. Outsourcing smaller components is generally more successful than outsourcing larger components.

_____ c. Outsourcing components of highly modular products is generally more successful than outsourcing components of monolithic products.

_____ d. Outsourcing is more successful when the interfaces for an outsourced component are well-defined.

_____ e. Outsourcing is more successful when the tools and languages used by both in-house and vendor developers are compatible.

_____ f. Outsourcing is more successful when an outsourced component's requirements are well-defined up-front.

_____ g. Outsourcing is more successful when the vendor and buyer organizations communicate well and overcome administrative obstacles to solve problems.

Other (please list)

_____ h. ____________________

_____ i. ____________________

_____ j. ____________________

15. Based on your experience, identify your level of agreement with each of the following assertions about which factors determine if *process* component (development activity) outsourcing will be successful. (Put the appropriate number from the scale in the blank next to each assertion)

Agreement Scale

Strongly Disagree		Neither Agree Nor Disagree		Strongly Agree
1	2	3	4	5

____ a. Outsourcing is more successful when organizational interfaces and responsibilities are well-defined than when organizational interfaces and responsibilities are loosely defined.

____ b. Outsourcing is more successful when organizational lifecycle models (e.g. prototyping, spiral, waterfall, incremental) used by both the vendor and buyer are the same rather than different.

____ c. Outsourcing is more successful when tools and methods allow information to flow easily between the vendor and in-house organization.

____ d. Outsourcing is more successful when the vendor's process maturity (e.g. SEI CMM rating) is higher.

____ e. Outsourcing is more successful when the in-house organization's process maturity (e.g. SEI CMM rating) is higher.

____ f. Outsourcing is more successful when the buyer's and vendor's process maturity levels (e.g. SEI CMM rating) are the same or close than when the ratings differ greatly.

Other (please list)

____ g. ____________________

____ h. ____________________

____ i. ____________________

16. Do you have any general comments about the survey, or software outsourcing in general?

Appendix D: Assertion Rules

	administrative overhead	control over final product	control over project management process	costs associated with changes	cultural, location, and language problems	development risks	development schedule	in-house effort spent on non-core activities	in-house personnel turnover	intellectual capital	likelihood of a failed or cancelled project	product quality	project costs	project learning curve	responsiveness to customer objectives	responsiveness to organizational objectives	rework	schedule flexibility	turf wars	visibility into the software development process
Outsourcing development of software in a domain familiar to the buyer (in-house organization)				IMP		IMP								IMP					IMP	
Outsourcing development of software in a domain familiar to the vendor						IMP					IMP	IMP		IMP						
Outsourcing development of software in a project domain with many available vendors													IMP							
Outsourcing development of software to a vendor with more experience with tools or languages.							IMP	IMP						IMP						
Outsourcing development of software to a vendor with		WOR				IMP	IMP						IMP	IMP					IMP	

	administrative overhead	control over final product	control over project management process	costs associated with changes	cultural, location, and language problems	development risks	development schedule	in-house effort spent on non-core activities	in-house personnel turnover	intellectual capital	likelihood of a failed or cancelled project	product quality	project costs	project learning curve	responsiveness to customer objectives	responsiveness to organizational objectives	rework	schedule flexibility	turf wars	visibility into the software development process
reusable design or code components.																				
Outsourcing projects with frequent reviews and inspections	**WOR**		**IMP**	**IMP**												**IMP**	**IMP**		**IMP**	**IMP**
Outsourcing project success is closely related to payment strategies and incentives in the vendor contract (e.g., fixed-price contracts projects are more or less successful than cost-plus type contracts). Choosing the right contractual payment strategy can:				**IMP**												**IMP**				**IMP**
Outsourcing project success is closely tied to the form of communication between the buyer and vendor. Choosing the	**IMP**	**IMP**		**IMP**	**IMP**										**IMP**	**IMP**	**IMP**		**IMP**	**IMP**

	administrative overhead	control over final product	control over project management process	costs associated with changes	cultural, location, and language problems	development risks	development schedule	in-house effort spent on non-core activities	in-house personnel turnover	intellectual capital	likelihood of a failed or cancelled project	product quality	project costs	project learning curve	responsiveness to customer objectives	responsiveness to organizational objectives	rework	schedule flexibility	turf wars	visibility into the software development process
appropriate forms of communication can:																				
Outsourcing projects are more successful when the buyer has more visibility into the vendor's development process. If visibility is built into the contract:																	IMP			IMP
Outsourcing projects where the buyer and vendor are located nearby.		IMP			IMP											IMP				IMP
Outsourcing projects where the buyer and vendor are located far apart (such as "off-shore" arrangements)			WOR		WOR						IMP					WOR				WOR
Outsourcing projects when the buyer and vendor have previously														IMP		IMP			IMP	

	administrative overhead	control over final product	control over project management process	costs associated with changes	cultural, location, and language problems	development risks	development schedule	in-house effort spent on non-core activities	in-house personnel turnover	intellectual capital	likelihood of a failed or cancelled project	product quality	project costs	project learning curve	responsiveness to customer objectives	responsiveness to organizational objectives	rework	schedule flexibility	turf wars	visibility into the software development process
worked together successfully.																				
Outsourcing development of software when the software vendor has a higher process maturity (e.g. SEI CMM rating).											IMP				IMP					
Outsourcing development of software when the buyer has a higher process maturity (e.g. SEI CMM rating).																			IMP	
Outsourcing development of software when the vendor has a successful track record.						IMP					IMP	IMP								
Outsourcing projects with more aggressive cost reduction goals are less likely to be successful than those with more modest cost reduction goals.		WOR	WOR	WOR		WOR										WOR		WOR		WOR

	administrative overhead	control over final product	control over project management process	costs associated with changes	cultural, location, and language problems	development risks	development schedule	in-house effort spent on non-core activities	in-house personnel turnover	intellectual capital	likelihood of a failed or cancelled project	product quality	project costs	project learning curve	responsiveness to customer objectives	responsiveness to organizational objectives	rework	schedule flexibility	turf wars	visibility into the software development process
Outsourcing projects with more aggressive schedule duration reduction goals are less likely to be successful than those with more modest schedule duration reduction goals.		WOR	WOR	WOR		WOR										WOR		WOR		WOR
Outsourcing development of software is more successful when the system is not complex.						IMP								IMP						
Outsourcing development of software is more successful when the system can be easily divided into components (highly modular).						IMP					IMP									

Appendix E: Outsourcing Decision Rules

Rule No	Factors (Antecedent)	Consequent	Effect	Impact	Direction
1	Both Process and Product Outsourcing	10. Improved/Increased Intellectual Capital	0.753	Small	Negative (Degrading)
2	Domain - Enterprise	6. Reduced Development Risks	0.885	Small	Positive (Improving)
3	Domain - Enterprise - Accounting	18. Improved Schedule Flexibility	1.493	Moderate	Positive (Improving)
4	Domain - Enterprise - Manufacturing Requirements Planning	19. Reduced Turf Wars	2.492	Large	Negative (Degrading)
4	Domain - Enterprise - Manufacturing Requirements Planning	1. Reduced Administrative Overhead	3.538	Large	Negative (Degrading)
4	Domain - Enterprise - Manufacturing Requirements Planning	13. Reduced Project Costs	3.348	Large	Negative (Degrading)
5	Domain - Enterprise - Order Entry Systems	14. Reduced Project Learning Curve	1.721	Moderate	Positive (Improving)
6	Domain - Enterprise - Web	8. Reduced In-House Effort spent on 'non-core' activities	1.102	Moderate	Negative (Degrading)
7	Domain - Shrinkwrap - Business	10. Improved/Increased Intellectual Capital	0.867	Small	Positive (Improving)
8	Domain - Shrinkwrap - Utilities	10. Improved/Increased	1.265	Moderate	Negative

Rule No	Factors (Antecedent)	Consequent	Effect	Impact	Direction
		Intellectual Capital			(Degrading)
8	Domain - Shrinkwrap - Utilities	1. Reduced Administrative Overhead	1.938	Moderate	Negative (Degrading)
8	Domain - Shrinkwrap - Utilities	5. Reduced Cultural, Location, and Language Problems	1.553	Moderate	Negative (Degrading)
9	Domain - Software Component Development	3. Increased Control over Outsourced Project Management Process	0.802	Small	Negative (Degrading)
9	Domain - Software Component Development	17. Reduced Rework	0.61	Small	Negative (Degrading)
9	Domain - Software Component Development	5. Reduced Cultural, Location, and Language Problems	0.532	Small	Positive (Improving)
10	Domain - Software Component Development - CASE Tools	13. Reduced Project Costs	2.722	Large	Positive (Improving)
10	Domain - Software Component Development - CASE Tools	10. Improved/Increased Intellectual Capital	1.48	Moderate	Negative (Degrading)
10	Domain - Software Component Development - CASE Tools	9. Reduced In-House Personnel Turnover	1.427	Moderate	Positive (Improving)
11	Domain - Software Component Development - Domain Frameworks	10. Improved/Increased Intellectual Capital	1.04	Moderate	Positive (Improving)
12	Domain - Software Component Development - Operating Systems	4. Decreased Costs Associated with Changes	1.154	Moderate	Negative (Degrading)

Rule No	Factors (Antecedent)	Consequent	Effect	Impact	Direction
13	Domain - Systems	10. Improved/Increased Intellectual Capital	0.323	Small	Negative (Degrading)
13	Domain - Systems	6. Reduced Development Risks	0.789	Small	Positive (Improving)
14	Domain - Systems - Avionics	5. Reduced Cultural, Location, and Language Problems	0.746	Small	Negative (Degrading)
15	Domain - Systems - Device Drivers	19. Reduced Turf Wars	0.966	Small	Negative (Degrading)
	NONE	7. Reduced Development Schedule Duration	0	Small	
16	Outsourcing Constant	20. Increased Visibility into the Software Development Process	1.377	Moderate	Negative (Degrading)
16	Outsourcing Constant	6. Reduced Development Risks	1.006	Moderate	Negative (Degrading)
16	Outsourcing Constant	1. Reduced Administrative Overhead	0.563	Small	Negative (Degrading)
16	Outsourcing Constant	5. Reduced Cultural, Location, and Language Problems	0.447	Small	Negative (Degrading)
16	Outsourcing Constant	4. Decreased Costs Associated with Changes	0.446	Small	Negative (Degrading)
16	Outsourcing Constant	2. Increased Control over Final Product	0.278	Small	Negative (Degrading)
16	Outsourcing Constant	14. Reduced Project Learning Curve	0.221	Small	Negative (Degrading)

Rule No	Factors (Antecedent)	Consequent	Effect	Impact	Direction
16	Outsourcing Constant	19. Reduced Turf Wars	0.166	Small	Negative (Degrading)
16	Outsourcing Constant	3. Increased Control over Outsourced Project Management Process	0.829	Small	Positive (Improving)
16	Outsourcing Constant	10. Improved/Increased Intellectual Capital	0.826	Small	Positive (Improving)
16	Outsourcing Constant	16. Improved Responsiveness to Organizational Objectives and Strategies	0.473	Small	Positive (Improving)
16	Outsourcing Constant	15. Improved Responsiveness to Customer Objectives	0.407	Small	Positive (Improving)
16	Outsourcing Constant	12. Improved Product Quality	0.397	Small	Positive (Improving)
16	Outsourcing Constant	13. Reduced Project Costs	0.348	Small	Positive (Improving)
16	Outsourcing Constant	8. Reduced In-House Effort spent on 'non-core' activities	0.335	Small	Positive (Improving)
16	Outsourcing Constant	17. Reduced Rework	0.15	Small	Positive (Improving)
16	Outsourcing Constant	18. Improved Schedule Flexibility	0.107	Small	Positive (Improving)
16	Outsourcing Constant	11. Decreased Likelihood of a Failed or Cancelled Project	0.043	Small	Positive (Improving)

Rule No	Factors (Antecedent)	Consequent	Effect	Impact	Direction
		Project			
16	Outsourcing Constant	9. Reduced In-House Personnel Turnover	0.003	Small	Positive (Improving)
17	Process - Applications Support	19. Reduced Turf Wars	2.573	Large	Positive (Improving)
18	Process - Configuration Management	11. Decreased Likelihood of a Failed or Cancelled Project	1.324	Moderate	Positive (Improving)
18	Process - Configuration Management	6. Reduced Development Risks	0.865	Small	Positive (Improving)
19	Process - Design	3. Increased Control over Outsourced Project Management Process	1.465	Moderate	Negative (Degrading)
20	Process - Documentation	1. Reduced Administrative Overhead	1.101	Moderate	Positive (Improving)
21	Process - Fielding	10. Improved/Increased Intellectual Capital	1.299	Moderate	Negative (Degrading)
22	Process - Maintenance	2. Increased Control over Final Product	0.618	Small	Positive (Improving)
23	Process - Reengineering	3. Increased Control over Outsourced Project Management Process	1.336	Moderate	Positive (Improving)
23	Process - Reengineering	20. Increased Visibility into the Software Development Process	1.1	Moderate	Positive (Improving)
23	Process - Reengineering	12. Improved Product	0.961	Small	Positive

Rule No	Factors (Antecedent)	Consequent	Effect	Impact	Direction
		Quality			(Improving)
24	Process - Software Engineering Support	19. Reduced Turf Wars	1.072	Moderate	Negative (Degrading)
24	Process - Software Engineering Support	16. Improved Responsiveness to Organizational Objectives and Strategies	1.011	Moderate	Negative (Degrading)
24	Process - Software Engineering Support	15. Improved Responsiveness to Customer Objectives	0.83	Small	Negative (Degrading)
24	Process - Software Engineering Support	9. Reduced In-House Personnel Turnover	0.288	Small	Negative (Degrading)
24	Process - Software Engineering Support	11. Decreased Likelihood of a Failed or Cancelled Project	0.689	Small	Positive (Improving)
25	Process - Tool Support	11. Decreased Likelihood of a Failed or Cancelled Project	1.392	Moderate	Negative (Degrading)
25	Process - Tool Support	19. Reduced Turf Wars	0.843	Small	Negative (Degrading)
26	Process - Training	10. Improved/Increased Intellectual Capital	0.912	Small	Positive (Improving)
27	Products - COTS	19. Reduced Turf Wars	0.867	Small	Negative (Degrading)
27	Products - COTS	12. Improved Product Quality	1.253	Moderate	Negative (Degrading)
27	Products - COTS	17. Reduced Rework	1.161	Moderate	Negative

Rule No	Factors (Antecedent)	Consequent	Effect	Impact	Direction
					(Degrading)
27	Products - COTS	8. Reduced In-House Effort spent on 'non-core' activities	0.795	Small	Negative (Degrading)
28	Products - Custom	13. Reduced Project Costs	1.07	Moderate	Negative (Degrading)
28	Products - Custom	20. Increased Visibility into the Software Development Process	0.625	Small	Positive (Improving)
29	Products - Customized Common Application	2. Increased Control over Final Product	1.08	Moderate	Negative (Degrading)
29	Products - Customized Common Application	3. Increased Control over Outsourced Project Management Process	0.789	Small	Negative (Degrading)
30	Products - None	20. Increased Visibility into the Software Development Process	2.377	Large	Positive (Improving)

Thank you for participating in the software development outsourcing decision support tool validation effort. I couldn't complete this work without your assistance. As a thank-you for completing this brief scenario questionnaire, **you will receive a $10 gift certificate to Amazon.com and the decision support tool.**

You can complete the form electronically – this document is form-enabled, so you can simply type in the text boxes and click on the check boxes and return it via e-mail to brian.hermann@computer.org

– OR –

You can print the form and return it by mail to:

Brian G. Hermann
16669 S 34th Way
Phoenix, AZ 85048-7876

Here are the steps:

1. On this page there are some brief background questions to assess your software and outsourcing experience.
2. On pages two through five are outsourcing project scenarios for four different software domains. If you have experience in a particular software domain, simply read the scenario and based on your experiences determine how the outsourcing will affect the project consequences as compared to a completely in-house effort.
   - Scenario 1 – **Enterprise Software**
   - Scenario 2 – **Shrink-Wrap Software**
   - Scenario 3 – **Software Component Development**
   - Scenario 4 – **Systems Software**
3. Complete all scenarios for which you have relevant experience.
4. Return the form to my by **March 27th, 2000** via e-mail or regular mail.

Thank you,

-Brian Hermann

What is your education level?

School	Degree

How many years of software development experience do you have?

How long have you been outsourcing software development (or been a software vendor)?

How many outsource projects have you been involved with?

Appendix F: Validation Scenarios

1. Enterprise Software Outsourcing Scenario: *Ahwatukee Foothills Accounting Company* (*AFAC*) has decided to develop a web-based accounting system for their clients' use. This product will be based on standard accounting principles and function much like their current accounting system with the addition of web-based functionality. While Ahwatukee Foothills accounting has a great knowledge of the accounting domain, they are in need of outside assistance to produce an Internet ready application.

You as the project manager at *AFAC* have decided to hire *Up and Dot Coming* (*U&DC*), an Internet company with a strong web background, but no accounting experience. Their tasks will be to design a web-based architecture and help re-engineer your current applications to fit that architecture. Your in-house developers will provide accounting expertise while learning Internet techniques from the *U&DC*.

Project scenario summary (VENDOR: U&DC) (BUYER: AFAC)

Domain – enterprise accounting for the web

Outsourced Product Type – customized common application

Outsourced Processes – design, reengineering, coding, training, and tools support

Based on your outsourcing experiences, how do you expect this scenario to affect the following outsourcing project consequences (as compared to an entirely in-house effort)?

Consequences	Decrease Dramatically	Decrease Significantly	Decrease Slightly	No Change	Increase Slightly	Increase Significantly	Increase Dramatically
Your control over final product	☐	☐	☐	☐	☐	☐	☐
Your control over project management process	☐	☐	☐	☐	☐	☐	☐
AFAC's Intellectual capital	☐	☐	☐	☐	☐	☐	☐
Product quality	☐	☐	☐	☐	☐	☐	☐
Responsiveness to customer objectives	☐	☐	☐	☐	☐	☐	☐
Responsiveness to organizational objectives and strategies	☐	☐	☐	☐	☐	☐	☐
Schedule flexibility	☐	☐	☐	☐	☐	☐	☐
AFAC's visibility into the software development process	☐	☐	☐	☐	☐	☐	☐
AFAC's administrative overhead	☐	☐	☐	☐	☐	☐	☐
Costs associated with changes	☐	☐	☐	☐	☐	☐	☐
Cultural, location, and language problems	☐	☐	☐	☐	☐	☐	☐
Development risks	☐	☐	☐	☐	☐	☐	☐
Development schedule duration	☐	☐	☐	☐	☐	☐	☐
In-house (*AFAC*) effort spent on non-core activities	☐	☐	☐	☐	☐	☐	☐
In-house (*AFAC*) personnel turnover	☐	☐	☐	☐	☐	☐	☐
Likelihood of a failed or cancelled project	☐	☐	☐	☐	☐	☐	☐
Project costs	☐	☐	☐	☐	☐	☐	☐
Project learning curve	☐	☐	☐	☐	☐	☐	☐
Rework	☐	☐	☐	☐	☐	☐	☐
Turf wars	☐	☐	☐	☐	☐	☐	☐

Comments on this scenario:

2. Shrink-Wrap Software Outsourcing Scenario: Your small software company *BizTools* has several popular business applications for client management and organization-wide fax routing. Your have been selected to manage the company's most ambitious effort to date – a network capable application to track employee location. The tentative software title is "Find 'Em", but that may change based on focus group analysis. Your biggest problem is that you don't have enough employees to meet your boss' ambitious release date. So you've decided to outsource some software development processes only. Your vendor, *TechStop*, will supply people and equipment to accomplish the various processes listed below.

Project scenario summary (VENDOR: TechStop) (BUYER: BizTools)

Domain – Shrink-wrap business utility application

Outsourced Product Type – None (only processes being outsourced)

Outsourced Processes – Configuration management, software engineering support, and testing

Based on your outsourcing experiences, how do you expect this scenario to affect the following outsourcing project consequences (as compared to an entirely in-house effort)?

Consequences	Decrease Dramatically	Decrease Significantly	Decrease Slightly	No Change	Increase Slightly	Increase Significantly	Increase Dramatically
BizTools' control over final product	☐	☐	☐	☐	☐	☐	☐
BizTools' control over project management process	☐	☐	☐	☐	☐	☐	☐
Intellectual capital	☐	☐	☐	☐	☐	☐	☐
Product quality	☐	☐	☐	☐	☐	☐	☐
Responsiveness to customer objectives	☐	☐	☐	☐	☐	☐	☐
Responsiveness to organizational objectives and strategies	☐	☐	☐	☐	☐	☐	☐
Schedule flexibility	☐	☐	☐	☐	☐	☐	☐
BizTools' visibility into the software development process	☐	☐	☐	☐	☐	☐	☐
BizTools' administrative overhead	☐	☐	☐	☐	☐	☐	☐
Costs associated with changes	☐	☐	☐	☐	☐	☐	☐
Cultural, location, and language problems	☐	☐	☐	☐	☐	☐	☐
Development risks	☐	☐	☐	☐	☐	☐	☐
Development schedule duration	☐	☐	☐	☐	☐	☐	☐
In-house (*BizTools*) effort spent on non-core activities	☐	☐	☐	☐	☐	☐	☐
In-house (*BizTools*) personnel turnover	☐	☐	☐	☐	☐	☐	☐
Likelihood of a failed or cancelled project	☐	☐	☐	☐	☐	☐	☐
Project costs	☐	☐	☐	☐	☐	☐	☐
Project learning curve	☐	☐	☐	☐	☐	☐	☐
Rework	☐	☐	☐	☐	☐	☐	☐
Turf wars	☐	☐	☐	☐	☐	☐	☐

Comments on this scenario:

3. Software Component Development Outsourcing Scenario: A European company, *ShowCASE* has been selected to develop the mobile portion of a new CASE tool for *MiniFirm* – the leading PC software company. This product will allow *MiniFirm* developers to access their full development tool suite from anywhere on the road. Since *ShowCase* is experienced in developing CASE tools and *MiniFirm* has developed many mobile applications, the match seems perfect. The vendor team will be responsible for design through testing and maintenance of the CASE applications and integration of the CASE functionality with the *MiniFirm* mobile application environment. The requirements and functionality are fairly well defined.

Project scenario summary (VENDOR: ShowCASE) (BUYER: MiniFirm)

Domain – Software component development – CASE tools

Outsourced Product Type – Custom

Outsourced Processes – Applications support, design, coding, documentation, testing, and maintenance

Based on your outsourcing experiences, how do you expect this scenario to affect the following outsourcing project consequences (as compared to an entirely in-house effort)?

Consequences	Decrease Dramatically	Decrease Significantly	Decrease Slightly	No Change	Increase Slightly	Increase Significantly	Increase Dramatically
MiniFirm's control over final product	☐	☐	☐	☐	☐	☐	☐
MiniFirm's control over project management process	☐	☐	☐	☐	☐	☐	☐
Intellectual capital	☐	☐	☐	☐	☐	☐	☐
Product quality	☐	☐	☐	☐	☐	☐	☐
Responsiveness to customer objectives	☐	☐	☐	☐	☐	☐	☐
Responsiveness to organizational objectives and strategies	☐	☐	☐	☐	☐	☐	☐
Schedule flexibility	☐	☐	☐	☐	☐	☐	☐
MiniFirm's visibility into the software development process	☐	☐	☐	☐	☐	☐	☐
MiniFirm's administrative overhead	☐	☐	☐	☐	☐	☐	☐
Costs associated with changes	☐	☐	☐	☐	☐	☐	☐
Cultural, location, and language problems	☐	☐	☐	☐	☐	☐	☐
Development risks	☐	☐	☐	☐	☐	☐	☐
Development schedule duration	☐	☐	☐	☐	☐	☐	☐
In-house (*MiniFirm)* effort spent on non-core activities	☐	☐	☐	☐	☐	☐	☐
In-house (*MiniFirm)* personnel turnover	☐	☐	☐	☐	☐	☐	☐
Likelihood of a failed or cancelled project	☐	☐	☐	☐	☐	☐	☐
Project costs	☐	☐	☐	☐	☐	☐	☐
Project learning curve	☐	☐	☐	☐	☐	☐	☐
Rework	☐	☐	☐	☐	☐	☐	☐
Turf wars	☐	☐	☐	☐	☐	☐	☐

Comments on this scenario:

4. Systems Software Outsourcing Scenario: Your aircraft company *FlyByNight* is developing the newest regional jet aircraft for worldwide sales to commercial airlines. Despite being a large organization, *FlyByNight* normally contracts with *Avomatic* for the avionics software within their commercial and military aircraft. Since *Avomatic* has experience and adaptable software products to use as a basis for this new regional jet's avionics, *FlyByNight* has selected their frequent partner for this project. *Avomatic* will be responsible for minor customization of their product, integration of the modified avionics into the new jet, testing the integrated avionics, and producing field ready software and firmware for the production line

Project scenario summary (VENDOR: Avomatic) (BUYER: FlyByNight)

Domain – Systems Software – Avionics

Outsourced Product Type– COTS

Outsourced Processes –Integration, testing, fielding, minor customization

Based on your outsourcing experiences, how do you expect this scenario to affect the following outsourcing project consequences (as compared to an entirely in-house effort)?

Consequences	Decrease Dramatically	Decrease Significantly	Decrease Slightly	No Change	Increase Slightly	Increase Significantly	Increase Dramatically
Control over final product	☐	☐	☐	☐	☐	☐	☐
Control over project management process	☐	☐	☐	☐	☐	☐	☐
Intellectual capital	☐	☐	☐	☐	☐	☐	☐
Product quality	☐	☐	☐	☐	☐	☐	☐
Responsiveness to customer objectives	☐	☐	☐	☐	☐	☐	☐
Responsiveness to organizational objectives and strategies	☐	☐	☐	☐	☐	☐	☐
Schedule flexibility	☐	☐	☐	☐	☐	☐	☐
Visibility into the software development process	☐	☐	☐	☐	☐	☐	☐
Administrative overhead	☐	☐	☐	☐	☐	☐	☐
Costs associated with changes	☐	☐	☐	☐	☐	☐	☐
Cultural, location, and language problems	☐	☐	☐	☐	☐	☐	☐
Development risks	☐	☐	☐	☐	☐	☐	☐
Development schedule duration	☐	☐	☐	☐	☐	☐	☐
In-house effort spent on non-core activities	☐	☐	☐	☐	☐	☐	☐
In-house personnel turnover	☐	☐	☐	☐	☐	☐	☐
Likelihood of a failed or cancelled project	☐	☐	☐	☐	☐	☐	☐
Project costs	☐	☐	☐	☐	☐	☐	☐
Project learning curve	☐	☐	☐	☐	☐	☐	☐
Rework	☐	☐	☐	☐	☐	☐	☐
Turf wars	☐	☐	☐	☐	☐	☐	☐

Comments on this scenario:

Appendix G: Validation Survey Results

Scenario #1

Consequences	Value	1	1 In Range	1 Sign	2	2 In Range	2 Sign	3	3 In Range	3 Sign	4	4 In Range	4 Sign	5	5 In Range	5 Sign	6	6 In Range	6 Sign	7	7 In Range	7 Sign
		Novice			Novice			Novice			Novice			Expert			Novice			Expert		
Control over final product	2.642				3	HIT	HIT				2	HIT	HIT	3	HIT	HIT				3	HIT	HIT
Control over project management process	3.911				3	HIT	HIT				3	HIT	HIT	4	HIT	HIT				4	HIT	HIT
Intellectual capital	4.985				6	MISS	HIT				2	MISS	MISS	5	HIT	HIT				4	HIT	HIT
Product quality	5.358				6	HIT	HIT				3	MISS	MISS	5	HIT	HIT				6	HIT	HIT
Responsiveness to customer objectives	4.407				5	HIT	HIT				3	MISS	MISS	4	HIT	HIT				5	HIT	HIT
Responsiveness to organizational objectives and strategies	4.473				5	HIT	HIT				3	MISS	MISS	4	HIT	HIT				5	HIT	HIT
Schedule flexibility	5.6				3	MISS	MISS				5	HIT	HIT	5	HIT	HIT				3	MISS	MISS
Visibility into the software development process	3.723				4	HIT	HIT				3	HIT	HIT	2	MISS	HIT				3	HIT	HIT
Administrative overhead	4.563				5	HIT	HIT				6	MISS	HIT	3	MISS	MISS				5	HIT	HIT
Costs associated with changes	4.446				6	MISS	HIT				4	HIT	HIT	6	MISS	HIT				6	MISS	HIT
Cultural, location, and language problems	4.447				5	HIT	HIT				6	MISS	HIT	7	MISS	HIT				4	HIT	HIT
Development risks	5.006				6	HIT	HIT				5	HIT	HIT	5	HIT	HIT				5	HIT	HIT
Development schedule duration	4				5	HIT	HIT				5	HIT	HIT	2	MISS	HIT				4	HIT	HIT

Scenario #1

Consequences	Value	1	1 In Range	1 Sign	2	2 In Range	2 Sign	3	3 In Range	3 Sign	4	4 In Range	4 Sign	5	5 In Range	5 Sign	6	6 In Range	6 Sign	7	7 In Range	7 Sign
		Novice			Novice			Novice			Novice			Expert			Novice			Expert		
In-house effort spent on non-core activities	4.767				2	MISS	MISS				5	HIT	HIT	3	MISS	MISS				4	HIT	HIT
In-house personnel turnover	3.997				2	MISS	HIT				5	MISS	MISS	3	HIT	HIT				3	HIT	HIT
Likelihood of a failed or cancelled project	5.349				3	MISS	MISS				6	HIT	HIT	4	MISS	HIT				2	MISS	MISS
Project costs	3.652				5	MISS	MISS				3	HIT	HIT	5	MISS	MISS				5	MISS	MISS
Project learning curve	4.221				3	MISS	MISS				5	HIT	HIT	6	MISS	HIT				5	HIT	HIT
Rework	3.85				3	HIT	HIT				5	MISS	MISS	6	MISS	MISS				4	HIT	HIT
Turf wars	5.009										6	HIT	HIT	5	HIT	HIT				5	HIT	HIT
Miss			0	0		8	5		0	0		8	6		10	4		0	0		4	3
Hit			0	0		11	14		0	0		12	14		10	16		0	0		16	17
Novice		Hit Ratio			Hit Ratio	58%	74%	Hit Ratio			Hit Ratio	60%	70%	Hit Ratio			Hit Ratio			Hit Ratio		
		Miss Ratio			Miss Ratio	42%	26%	Miss Ratio			Miss Ratio	40%	30%	Miss Ratio			Miss Ratio			Miss Ratio		
Expert		Hit Ratio													50%	80%					80%	85%
		Miss Ratio													50%	20%					20%	15%

Scenario #1																		
Consequences	Value	8	8 In Range	8 Sign	9	9 In Range	9 Sign	10	10 In Range	10 Sign	11	11 In Range	11 Sign	12	12 In Range	12 Sign	13	13 In Range	13 Sign
		Expert			Expert			Novice			Expert			Novice			Expert		
Control over final product	2.642	5	MISS	MISS	3	HIT	HIT	2	HIT	HIT				2	HIT	HIT	3	HIT	HIT
Control over project management process	3.911	6	MISS	MISS	3	HIT	HIT	2	MISS	HIT				3	HIT	HIT	1	MISS	HIT
Intellectual capital	4.985	4	HIT	HIT	4	HIT	HIT	5	HIT	HIT				6	MISS	HIT	4	HIT	HIT
Product quality	5.358	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT				3	MISS	MISS	5	HIT	HIT
Responsiveness to customer objectives	4.407	4	HIT	HIT	5	HIT	HIT	3	MISS	MISS				3	MISS	MISS	4	HIT	HIT
Responsiveness to organizational objectives and strategies	4.473	5	HIT	HIT	5	HIT	HIT	3	MISS	MISS				3	MISS	MISS	4	HIT	HIT
Schedule flexibility	5.6	5	HIT	HIT	3	MISS	MISS	2	MISS	MISS				3	MISS	MISS	3	MISS	MISS
Visibility into the software development process	3.723	5	MISS	MISS	3	HIT	HIT	2	MISS	HIT				5	MISS	MISS	1	MISS	HIT
Administrative overhead	4.563	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT				5	HIT	HIT	7	MISS	HIT
Costs associated with changes	4.446	5	HIT	HIT	5	HIT	HIT	6	MISS	HIT				6	MISS	HIT	5	HIT	HIT
Cultural, location, and language problems	4.447	4	HIT	HIT	4	HIT	HIT	5	HIT	HIT				6	MISS	HIT	5	HIT	HIT
Development risks	5.006	4	MISS	HIT	5	HIT	HIT	6	HIT	HIT				6	HIT	HIT	6	HIT	HIT
Development schedule duration	4	5	HIT	HIT	4	HIT	HIT	3	HIT	HIT				6	MISS	HIT	5	HIT	HIT
In-house effort spent on non-core activities	4.767	4	HIT	HIT	4	HIT	HIT							6	MISS	HIT	5	HIT	HIT
In-house personnel turnover	3.997	4	HIT	HIT	5	MISS	MISS	5	MISS	MISS				5	MISS	MISS	5	MISS	MISS

Scenario #1

Consequences	Value	8	8 In Range	8 Sign	9	9 In Range	9 Sign	10	10 In Range	10 Sign	11	11 In Range	11 Sign	12	12 In Range	12 Sign	13	13 In Range	13 Sign
		Expert			Expert			Novice			Expert			Novice			Expert		
Likelihood of a failed or cancelled project	5.349	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT				5	HIT	HIT	5	HIT	HIT
Project costs	3.652	5	MISS	MISS	5	MISS	MISS	5	MISS	MISS				6	MISS	MISS	4	HIT	HIT
Project learning curve	4.221	5	HIT	HIT	6	MISS	HIT							6	MISS	HIT	7	MISS	HIT
Rework	3.85	4	HIT	HIT	5	MISS	MISS	5	MISS	MISS				5	MISS	MISS	4	HIT	HIT
Turf wars	5.009	6	HIT	HIT	5	HIT	HIT	6	HIT	HIT				3	MISS	MISS	5	HIT	HIT
Miss			5	4		5	4		9	6		0	0		15	9		6	2
Hit			15	16		15	16		9	12		0	0		5	11		14	18
Novice		Hit Ratio			Hit Ratio			Hit Ratio	50%	67%	Hit Ratio			Hit Ratio	25%	55%	Hit Ratio		
		Miss Ratio			Miss Ratio			Miss Ratio	50%	33%	Miss Ratio			Miss Ratio	75%	45%	Miss Ratio		
Expert			75%	80%		75%	80%											70%	90%
			25%	20%		25%	20%											30%	10%

Scenario #2

Consequences	Value	1	1 In Range	1 Sign	2	2 In Range	2 Sign	3	3 In Range	3 Sign	4	4 In Range	4 Sign	5	5 In Range	5 Sign	6	6 In Range	6 Sign	7	7 In Range	7 Sign
		Novice			Novice			Novice			Novice			Expert			Novice			Expert		
Control over final product	3.722										4	HIT	HIT	6	MISS	MISS				3	HIT	HIT
Control over project management process	4.829										3	MISS	MISS	5	HIT	HIT				4	HIT	HIT
Intellectual capital	4.428										4	HIT	HIT	4	HIT	HIT				4	HIT	HIT
Product quality	4.397										3	MISS	MISS	5	HIT	HIT				4	HIT	HIT
Responsiveness to customer objectives	3.577										3	HIT	HIT	4	HIT	HIT				4	HIT	HIT
Responsiveness to organizational objectives and strategies	3.462										3	HIT	HIT	5	MISS	MISS				4	HIT	HIT
Schedule flexibility	4.107										5	HIT	HIT	4	HIT	HIT				5	HIT	HIT
Visibility into the software development process	5										3	MISS	MISS	6	HIT	HIT				3	MISS	MISS
Administrative overhead	6.501										5	MISS	HIT	5	MISS	HIT				5	MISS	HIT
Costs associated with changes	4.446										5	HIT	HIT	5	HIT	HIT				5	HIT	HIT
Cultural, location, and language problems	6										4	MISS	HIT	5	HIT	HIT				4	MISS	HIT
Development risks	4.141										5	HIT	HIT	2	MISS	MISS				5	HIT	HIT
Development schedule duration	4										6	MISS	HIT	5	HIT	HIT				4	HIT	HIT
In-house effort spent on non-core activities	3.665										5	MISS	MISS	3	HIT	HIT				4	HIT	HIT
In-house personnel turnover	4.285										5	HIT	HIT	4	HIT	HIT				5	HIT	HIT

Scenario #2

Consequences	Value	1	1 In Range	1 Sign	2	2 In Range	2 Sign	3	3 In Range	3 Sign	4	4 In Range	4 Sign	5	5 In Range	5 Sign	6	6 In Range	6 Sign	7	7 In Range	7 Sign
		Novice			Novice			Novice			Novice			Expert			Novice			Expert		
Likelihood of a failed or cancelled project	1.944										5	MISS	MISS	2	HIT	HIT				5	MISS	MISS
Project costs	3.652										3	HIT	HIT	4	HIT	HIT				5	MISS	MISS
Project learning curve	4.221										6	MISS	HIT	4	HIT	HIT				5	HIT	HIT
Rework	3.85										5	MISS	MISS	3	HIT	HIT				5	MISS	MISS
Turf wars	5.238										5	HIT	HIT	2	MISS	MISS				5	HIT	HIT
Miss			0	0		0	0		0	0		10	6		5	4		0	0		6	4
Hit			0	0		0	0		0	0		10	14		15	16		0	0		14	16
Novice		Hit Ratio			Hit Ratio			Hit Ratio			Hit Ratio	50%	70%	Hit Ratio			Hit Ratio			Hit Ratio		
		Miss Ratio			Miss Ratio			Miss Ratio			Miss Ratio	50%	30%	Miss Ratio			Miss Ratio			Miss Ratio		

Scenario #2																			
Consequences	Value	8	8 In Range	8 Sign	9	9 In Range	9 Sign	10	10 In Range	10 Sign	11	11 In Range	11 Sign	12	12 In Range	12 Sign	13	13 In Range	13 Sign
		Expert			Expert			Novice			Expert			Novice			Expert		
Control over final product	3.722	4	HIT	HIT	3	HIT	HIT	3	HIT	HIT	3	HIT	HIT	3	HIT	HIT	4	HIT	HIT
Control over project management process	4.829	4	HIT	HIT	3	MISS	MISS	3	MISS	MISS	4	HIT	HIT	5	HIT	HIT	4	HIT	HIT
Intellectual capital	4.428	4	HIT	HIT	4	HIT	HIT	2	MISS	MISS				3	MISS	MISS	4	HIT	HIT
Product quality	4.397	4	HIT	HIT	4	HIT	HIT	5	HIT	HIT	4	HIT	HIT	2	MISS	MISS	4	HIT	HIT
Responsiveness to customer objectives	3.577	4	HIT	HIT	4	HIT	HIT	3	HIT	HIT	4	HIT	HIT	3	HIT	HIT	3	HIT	HIT
Responsiveness to organizational objectives and strategies	3.462	4	HIT	HIT	4	HIT	HIT	2	MISS	HIT	3	HIT	HIT	3	HIT	HIT	4	HIT	HIT
Schedule flexibility	4.107	5	HIT	HIT	4	HIT	HIT	2	MISS	MISS	5	HIT	HIT	3	MISS	MISS	5	HIT	HIT
Visibility into the software development process	5	5	HIT	HIT	4	HIT	HIT	2	MISS	MISS	4	HIT	HIT	5	HIT	HIT	4	HIT	HIT
Administrative overhead	6.501	6	HIT	HIT	4	MISS	HIT	5	MISS	HIT	6	HIT	HIT	5	MISS	HIT	6	HIT	HIT
Costs associated with changes	4.446	6	MISS	HIT	4	HIT	HIT	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT
Cultural, location, and language problems	6	5	HIT	HIT	4	MISS	HIT	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT
Development risks	4.141	5	HIT	HIT	4	HIT	HIT	5	HIT	HIT	6	MISS	HIT	5	HIT	HIT	5	HIT	HIT
Development schedule duration	4	5	HIT	HIT	4	HIT	HIT	3	HIT	HIT	3	HIT	HIT	5	HIT	HIT	3	HIT	HIT
In-house effort spent on non-core activities	3.665	4	HIT	HIT	4	HIT	HIT	4	HIT	HIT	4	HIT	HIT	5	MISS	MISS	6	MISS	MISS
In-house personnel turnover	4.285	4	HIT	HIT	4	HIT	HIT	5	HIT	HIT	6	MISS	HIT	4	HIT	HIT	4	HIT	HIT

Scenario #2

Consequences	Value	8	8 In Range	8 Sign	9	9 In Range	9 Sign	10	10 In Range	10 Sign	11	11 In Range	11 Sign	12	12 In Range	12 Sign	13	13 In Range	13 Sign
		Expert			Expert			Novice			Expert			Novice			Expert		
Likelihood of a failed or cancelled project	1.944	5	MISS	MISS	4	MISS	HIT	5	MISS	MISS	4	MISS	HIT	5	MISS	MISS	3	MISS	HIT
Project costs	3.652	4	HIT	HIT	4	HIT	HIT	6	MISS	MISS	6	MISS	MISS	5	MISS	MISS	4	HIT	HIT
Project learning curve	4.221	4	HIT	HIT	5	HIT	HIT	3	MISS	MISS	5	HIT	HIT	4	HIT	HIT	5	HIT	HIT
Rework	3.85	5	MISS	MISS	4	HIT	HIT	5	MISS	MISS	6	MISS	MISS	5	MISS	MISS	5	MISS	MISS
Turf wars	5.238	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT	6	HIT	HIT	3	MISS	MISS	5	HIT	HIT
Miss			3	2		4	1		10	8		5	2		9	8		3	2
Hit			17	18		16	19		10	12		14	17		11	12		17	18
Novice		Hit Ratio			Hit Ratio			Hit Ratio	50%	60%	Hit Ratio			Hit Ratio	55%	60%	Hit Ratio		
		Miss Ratio			Miss Ratio			Miss Ratio	50%	40%	Miss Ratio			Miss Ratio	45%	40%	Miss Ratio		

Scenario #3

Consequences	Value	1	1 In Range	1 Sign	2	2 In Range	2 Sign	3	3 In Range	3 Sign	4	4 In Range	4 Sign	5	5 In Range	5 Sign	6	6 In Range	6 Sign	7	7 In Range	7 Sign
		Novice			Novice			Novice			Novice			Expert			Novice			Expert		
Control over final product	4.34							3	MISS	MISS	3	MISS	MISS	5	HIT	HIT	3	MISS	MISS	3	MISS	MISS
Control over project management process	2.562							3	HIT	HIT	3	HIT	HIT	4	MISS	HIT	4	MISS	HIT	3	HIT	HIT
Intellectual capital	2.593							4	MISS	HIT	3	HIT	HIT	3	HIT	HIT	3	HIT	HIT	3	HIT	HIT
Product quality	4.397							3	MISS	MISS	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT	5	HIT	HIT
Responsiveness to customer objectives	4.407							4	HIT	HIT	4	HIT	HIT	5	HIT	HIT	3	MISS	MISS	5	HIT	HIT
Responsiveness to organizational objectives and strategies	4.473							1	MISS	MISS	4	HIT	HIT	5	HIT	HIT	3	MISS	MISS	5	HIT	HIT
Schedule flexibility	4.107							3	MISS	MISS	5	HIT	HIT	5	HIT	HIT	3	MISS	MISS	5	HIT	HIT
Visibility into the software development process	3.248							1	MISS	HIT	3	HIT	HIT	4	HIT	HIT	4	HIT	HIT	3	HIT	HIT
Administrative overhead	3.462							5	MISS	MISS	5	MISS	MISS	2	MISS	HIT	5	MISS	MISS	5	MISS	MISS
Costs associated with changes	4.446							3	MISS	MISS	3	MISS	MISS	6	MISS	HIT	6	MISS	HIT	5	HIT	HIT
Cultural, location, and language problems	3.915							5	MISS	MISS	5	MISS	MISS	4	HIT	HIT	6	MISS	MISS	4	HIT	HIT
Development risks	4.121							5	HIT	HIT	3	MISS	MISS	3	MISS	MISS	5	HIT	HIT	5	HIT	HIT
Development schedule duration	4							5	HIT	HIT	3	HIT	HIT	3	HIT	HIT	3	HIT	HIT	4	HIT	HIT
In-house effort spent on non-core activities	3.665							3	HIT	HIT	5	MISS	MISS	3	HIT	HIT	5	MISS	MISS	3	HIT	HIT
In-house personnel turnover	2.57							3	HIT	HIT	4	MISS	HIT	2	HIT	HIT	4	MISS	HIT	4	MISS	HIT

Scenario #3

Consequences	Value	1	1 In Range	1 Sign	2	2 In Range	2 Sign	3	3 In Range	3 Sign	4	4 In Range	4 Sign	5	5 In Range	5 Sign	6	6 In Range	6 Sign	7	7 In Range	7 Sign
		Novice			Novice			Novice			Novice			Expert			Novice			Expert		
Likelihood of a failed or cancelled project	3.957							3	HIT	HIT	5	MISS	MISS	3	HIT	HIT	5	MISS	MISS	3	HIT	HIT
Project costs	2							5	MISS	MISS	3	HIT	HIT	3	HIT	HIT	4	MISS	HIT	3	HIT	HIT
Project learning curve	4.221							5	HIT	HIT	3	MISS	MISS	4	HIT	HIT	4	HIT	HIT	4	HIT	HIT
Rework	4.46							2	MISS	MISS	3	MISS	MISS	4	HIT	HIT	3	MISS	MISS	3	MISS	MISS
Turf wars	1.593							1	HIT	HIT	5	MISS	MISS	2	HIT	HIT	4	MISS	HIT	4	MISS	HIT
Miss			0	0		0	0		11	9		11	10		4	1		14	9		5	3
Hit			0	0		0	0		9	11		9	10		16	19		6	11		15	17
Novice		Hit Ratio			Hit Ratio			Hit Ratio	45%	55%	Hit Ratio	45%	50%	Hit Ratio			Hit Ratio	30%	55%	Hit Ratio		
		Miss Ratio			Miss Ratio			Miss Ratio	55%	45%	Miss Ratio	55%	50%	Miss Ratio			Miss Ratio	70%	45%	Miss Ratio		
Expert		Hit Ratio													80%	95%					75%	85%
		Miss Ratio													20%	5%					25%	15%

Scenario #3

Consequences	Value	8	8 In Range	8 Sign	9	9 In Range	9 Sign	10	10 In Range	10 Sign	11	11 In Range	11 Sign	12	12 In Range	12 Sign	13	13 In Range	13 Sign
		Expert			Expert			Novice			Expert			Novice			Expert		
Control over final product	4.34	4	HIT	HIT	4	HIT	HIT							6	MISS	HIT	4	HIT	HIT
Control over project management process	2.562	4	MISS	HIT	3	HIT	HIT							6	MISS	MISS	2	HIT	HIT
Intellectual capital	2.593	4	MISS	HIT	2	HIT	HIT							5	MISS	MISS	2	HIT	HIT
Product quality	4.397	4	HIT	HIT	4	HIT	HIT							5	HIT	HIT	6	MISS	HIT
Responsiveness to customer objectives	4.407	4	HIT	HIT	5	HIT	HIT							6	MISS	HIT	2	MISS	MISS
Responsiveness to organizational objectives and strategies	4.473	4	HIT	HIT	5	HIT	HIT							6	MISS	HIT	4	HIT	HIT
Schedule flexibility	4.107	4	HIT	HIT	4	HIT	HIT							5	HIT	HIT	5	HIT	HIT
Visibility into the software development process	3.248	4	HIT	HIT	5	MISS	MISS							3	HIT	HIT	3	HIT	HIT
Administrative overhead	3.462	4	HIT	HIT	5	MISS	MISS							4	HIT	HIT	6	MISS	MISS
Costs associated with changes	4.446	4	HIT	HIT	5	HIT	HIT							3	MISS	MISS	5	HIT	HIT
Cultural, location, and language problems	3.915	4	HIT	HIT	4	HIT	HIT							3	HIT	HIT	5	MISS	MISS
Development risks	4.121	4	HIT	HIT	5	HIT	HIT							2	MISS	MISS	5	HIT	HIT
Development schedule duration	4	4	HIT	HIT	4	HIT	HIT							3	HIT	HIT	5	HIT	HIT
In-house effort spent on non-core activities	3.665	4	HIT	HIT	4	HIT	HIT							4	HIT	HIT	4	HIT	HIT
In-house personnel turnover	2.57	4	MISS	HIT	3	HIT	HIT							3	HIT	HIT	4	MISS	HIT

Scenario #3

Consequences	Value	8	8 In Range	8 Sign	9	9 In Range	9 Sign	10	10 In Range	10 Sign	11	11 In Range	11 Sign	12	12 In Range	12 Sign	13	13 In Range	13 Sign
		Expert			Expert			Novice			Expert			Novice			Expert		
Likelihood of a failed or cancelled project	3.957	4	HIT	HIT	5	MISS	MISS							2	MISS	HIT	3	HIT	HIT
Project costs	2	4	MISS	HIT	5	MISS	MISS							3	HIT	HIT	5	MISS	MISS
Project learning curve	4.221	4	HIT	HIT	5	HIT	HIT							3	MISS	MISS	5	HIT	HIT
Rework	4.46	4	HIT	HIT	5	HIT	HIT							3	MISS	MISS	5	HIT	HIT
Turf wars	1.593	4	MISS	HIT	6	MISS	MISS							2	HIT	HIT	6	MISS	MISS
Miss			5	0		5	5		0	0		0	0		10	6		7	5
Hit			15	20		15	15		0	0		0	0		10	14		13	15
Novice		Hit Ratio			Hit Ratio			Hit Ratio			Hit Ratio			Hit Ratio	50%	70%	Hit Ratio		
		Miss Ratio			Miss Ratio			Miss Ratio			Miss Ratio			Miss Ratio	50%	30%	Miss Ratio		
Expert			75%	100%		75%	75%											65%	75%
			25%	0%		25%	25%											35%	25%

Scenario #4																						
Consequences	Value	1	1 In Range	1 Sign	2	2 In Range	2 Sign	3	3 In Range	3 Sign	4	4 In Range	4 Sign	5	5 In Range	5 Sign	6	6 In Range	6 Sign	7	7 In Range	7 Sign
		Novice			Novice			Novice			Novice			Expert			Novice			Expert		
Control over final product	2.642	2	HIT	HIT							3	HIT	HIT									
Control over project management process	4.04	3	MISS	MISS							3	MISS	MISS									
Intellectual capital	2.451	3	HIT	HIT																		
Product quality	3.144	4	HIT	HIT							5	MISS	MISS									
Responsiveness to customer objectives	4.407	3	MISS	MISS							4	HIT	HIT									
Responsiveness to organizational objectives and strategies	4.473	4	HIT	HIT							5	HIT	HIT									
Schedule flexibility	4.107	3	MISS	MISS							3	MISS	MISS									
Visibility into the software development process	2.623	3	HIT	HIT							3	HIT	HIT									
Administrative overhead	4.563	6	MISS	HIT							5	HIT	HIT									
Costs associated with changes	4.446	6	MISS	HIT							5	HIT	HIT									
Cultural, location, and language problems	5.193	4	MISS	HIT							5	HIT	HIT									
Development risks	3.332	5	MISS	MISS							3	HIT	HIT									
Development schedule duration	4	6	MISS	HIT							3	HIT	HIT									
In-house effort spent on non-core activities	4.46	6	MISS	HIT							5	HIT	HIT									
In-house personnel turnover	3.997	4	HIT	HIT							4	HIT	HIT									

Scenario #4

Consequences	Value	1	1 In Range	1 Sign	2	2 In Range	2 Sign	3	3 In Range	3 Sign	4	4 In Range	4 Sign	5	5 In Range	5 Sign	6	6 In Range	6 Sign	7	7 In Range	7 Sign
		Novice			Novice			Novice			Novice			Expert			Novice			Expert		
Likelihood of a failed or cancelled project	3.957	6	MISS	MISS							3	HIT	HIT									
Project costs	3.652	5	MISS	MISS							3	HIT	HIT									
Project learning curve	4.221	3	MISS	MISS							3	MISS	MISS									
Rework	5.011	5	HIT	HIT							4	MISS	HIT									
Turf wars	5.033	5	HIT	HIT							5	HIT	HIT									
Miss			12	7		0	0		0	0		5	4		0	0		0	0		0	0
Hit			8	13		0	0		0	0		14	15		0	0		0	0		0	0
Novice		Hit Ratio	40%	65%	Hit Ratio			Hit Ratio			Hit Ratio	74%	79%	Hit Ratio			Hit Ratio			Hit Ratio		
		Miss Ratio	60%	35%	Miss Ratio			Miss Ratio			Miss Ratio	26%	21%	Miss Ratio			Miss Ratio			Miss Ratio		
Expert		Hit Ratio																				
		Miss Ratio																				

Scenario #4

Consequences	Value	8	8 In Range	8 Sign	9	9 In Range	9 Sign	10	10 In Range	10 Sign	11	11 In Range	11 Sign	12	12 In Range	12 Sign	13	13 In Range	13 Sign
		Expert			Expert			Novice			Expert			Novice			Expert		
Control over final product	2.642	5	MISS	MISS	2	HIT	HIT							4	MISS	HIT	3	HIT	HIT
Control over project management process	4.04	5	HIT	HIT	2	MISS	MISS							4	HIT	HIT	4	HIT	HIT
Intellectual capital	2.451	3	HIT	HIT	2	HIT	HIT							5	MISS	MISS	3	HIT	HIT
Product quality	3.144	4	HIT	HIT	5	MISS	MISS							6	MISS	MISS	5	MISS	MISS
Responsiveness to customer objectives	4.407	4	HIT	HIT	5	HIT	HIT							6	MISS	HIT	6	MISS	HIT
Responsiveness to organizational objectives and strategies	4.473	4	HIT	HIT	5	HIT	HIT							6	MISS	HIT	5	HIT	HIT
Schedule flexibility	4.107	5	HIT	HIT	4	HIT	HIT							6	MISS	HIT	4	HIT	HIT
Visibility into the software development process	2.623	5	MISS	MISS	1	MISS	HIT							6	MISS	MISS	3	HIT	HIT
Administrative overhead	4.563	4	HIT	HIT	4	HIT	HIT							4	HIT	HIT	5	HIT	HIT
Costs associated with changes	4.446	5	HIT	HIT	4	HIT	HIT							3	MISS	MISS	5	HIT	HIT
Cultural, location, and language problems	5.193	4	MISS	HIT	5	HIT	HIT							4	MISS	HIT	5	HIT	HIT
Development risks	3.332	5	MISS	MISS	4	HIT	HIT							2	MISS	HIT	5	MISS	MISS
Development schedule duration	4	5	HIT	HIT	4	HIT	HIT							2	MISS	HIT	3	HIT	HIT
In-house effort spent on non-core activities	4.46	4		HIT	5	HIT	HIT							4	HIT	HIT	4	HIT	HIT
In-house personnel turnover	3.997	4	HIT	HIT	4	HIT	HIT							4	HIT	HIT	4	HIT	HIT

Scenario #4

Consequences	Value	8	8 In Range	8 Sign	9	9 In Range	9 Sign	10	10 In Range	10 Sign	11	11 In Range	11 Sign	12	12 In Range	12 Sign	13	13 In Range	13 Sign
		Expert			Expert			Novice			Expert			Novice			Expert		
Likelihood of a failed or cancelled project	3.957	5	MISS	MISS	4	HIT	HIT							1	MISS	HIT	5	MISS	MISS
Project costs	3.652	4	HIT	HIT	4	HIT	HIT							2	MISS	HIT	4	HIT	HIT
Project learning curve	4.221	4	HIT	HIT	6	MISS	HIT							2	MISS	MISS	4	HIT	HIT
Rework	5.011	4	MISS	HIT	5	HIT	HIT							2	MISS	MISS	4	MISS	HIT
Turf wars	5.033	4	MISS	HIT	6	HIT	HIT							4	MISS	HIT	4	MISS	HIT
Miss			7	4		4	2		0	0		0	0		16	6		6	3
Hit			12	16		16	18		0	0		0	0		4	14		14	17
Novice		Hit Ratio			Hit Ratio			Hit Ratio			Hit Ratio			Hit Ratio	20%	70%	Hit Ratio		
		Miss Ratio			Miss Ratio			Miss Ratio			Miss Ratio			Miss Ratio	80%	30%	Miss Ratio		
Expert			63%	80%		80%	90%											70%	85%
			37%	20%		20%	10%											30%	15%